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CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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NEW PHENOMENA OF INVISIBLE RADIATIONS.

There seems to be no lag in the interest manifested in the invisible forms of radiation, either on the part of the scientific world or the general public. In fact any tendency on the part of the latter to forget that there is such a substance as radium is very quickly checked by some new and perhaps startling discovery. Thus, the announcement made by Curie, that radium acts as a continuous generator of heat, is followed up by Wien, in a paper appearing in the *Physikalische Zeitschrift*, which states that the same mysterious substance can be used to produce continuously an electric current. Wien enclosed radium bromide in a glass tube, into which a platinum wire was fused. This tube was suspended by a glass thread in a larger tube, into which a second platinum wire was melted. The current was obtained of the order of 3×10^{-12} ampere. The explanation of this action is that, according to Rutherford, both positively and negatively charged particles or electrons are thrown off by the radium. The positive electron is many times larger than the negative, and, by means of a proper sieve, can be separated from the latter. In the apparatus just described, the inner glass tube acts as the sieve, retaining the positive electrons and letting the negative pass more or less freely.

The current obtained in this way by Wien, while exceedingly small, allowed a computation to be made of the mass of radiated particles. The figures obtained show that this is far too small to be detected by weighing. The energy, according to the Rutherford and Soddy disintegration theory, of course is due to the breaking up of the radium atoms, and, on account of the high velocity of the particles, is considerable. Four milligrammes of radium give off sixty ergs per second in the positive electrons, and 8.7 ergs in the negative.

New Observations with N-Rays.

Another group of rays, discovered by Blondlot, and called by him N-rays, have received less general attention, as the phenomena observed are not so startling as others connected with radioactivity. It will be remembered that these rays were discovered by the effect which they exert on the small electric spark, rendering it more luminous. They exert the same effect upon the luminous flame; and now M. Blondlot announces that it is not essential for these rays to fall upon an object to render it more visible, but the same effect is obtained if they penetrate the eye. These rays are given out from various luminous objects as well as from objects which have been exposed to sunlight. He happened to have his eye fixed on a small, feebly illuminated band of paper. A brick which had been exposed to sunlight was brought near his face, with the exposed surface toward him. He at once saw the band of paper brighten up, and the effect disappeared upon removing the brick or turning its unexposed side toward his face. It was not affected by enclosing the brick in a box closed with black paper.

Effect Not Entirely Physiological.

A simple experiment is to darken a room until the face of a clock on the wall is only feebly visible. By bringing a solarized brick or pebble near the eye, the face of the clock becomes sharply outlined, and possibly the hands are seen. No explanation is offered of this curious phenomenon. It can not be assumed to be entirely physiological, as in the earlier experiments photography was made use of in studying the action of these rays on sparks. These rays are absorbed by moisture, but Blondlot has found that saline solutions allow them to pass freely in all directions, and that such solutions, particularly hyposulphite of soda, may be used to store up the rays, and may thus take the place of the Nernst lamp as a source.

WEATHERPROOF INSULATION OR BARE CONDUCTORS.

At the recent meeting of the American Institute of Electrical Engineers, attention was called to the false feeling of security which is inspired by the use of weatherproof insulation on outside conductors. As an insulator, the usual coating of braid and compound can not be compared with rubber, and after continued exposure, particularly when wet, it loses much of its insulating property, so that a wire thus protected is little better than a bare conductor. Indeed, it may be more dangerous, as due to carelessness or ignorance, an attempt may be made to handle wires covered in this way while they are alive. Another objection to this insulation is, much of it will not stand the weather, and, sooner or later, hangs in festoons along the whole line. Where a company owns its right of way, it would seem better to use bare wires and to spend the money which would otherwise have gone into insulation, in securing better line construction. When the line runs on a public highway, there are, of course, other considerations that enter into the matter, and the company may not be allowed to erect bare wire, yet it is such lines that are most likely to be handled by wiremen who are careless or ignorant of the voltage of the circuit.

The use of rubber gloves was also criticised at the meeting, for the same reason. Such gloves, while apparently in good condition, may be far from it, and the feeling of security which they give to the wearer may lead him to careless handling of wires. Defects in these gloves may not be noticeable at low voltages, while a breakdown at a high voltage might be discovered only after an accident. These warnings are timely, as all of us would rather recognize the dangers and act accordingly, than rely upon protective devices which are anything but perfect.

THE EDISON PORTLAND CEMENT COMPANY.

At New Village, N. J., there has been developed one of the most complete plants in the world for the manufacture of high-grade Portland cement. This plant has been designed entirely by Thomas A. Edison. The company is fortunate in having a good acreage of land which abounds in cement rock and limestone of the best quality for making good cement, and also in having the use of machinery which has been developed to a state of perfection for this class of work.

The machinery used in this plant is not new, but is the result of the experimental work which was done at Edison, N. J., in the iron ore plant Mr. Edison designed. This, of course, does not include the roasters, which were designed solely for the cement mill. Although heavy engines are required for driving the giant and smaller rolls used in crushing the rock and clinkers, electricity is made use of almost exclusively where it is at all possible. Miles of belt and bucket conveyors are driven by electric motors, as well as exhaust fans in the several departments. The enormous roasters are operated electrically, and it is a remarkable sight to see these giant shells being revolved by the relatively insignificant twenty-five-horse-power motor.

From a popular point of view the Edison cement works is remarkable in every way, and from a technical point of view the working out of the several engineering propositions has been eminently satisfactory.

METALLIC OXIDES AS CONDUCTORS OF ELECTRICITY.

At a recent meeting of the German Bunsen Society for applied physical chemistry, Dr. O. Frölich presented a paper giving a description of a new resistance furnace which he has devised. Electric furnaces usually depend for their action upon heat developed in arcs, by the passage of a heavy current through the material which is to be treated, or through resistances arranged either in the material to be treated or in the walls of the furnace. In this new type, the walls of the furnace are themselves made use of as the high-resistance conductors through which the current is passed. There is thus no need of introducing carbon cores, which are sometimes undesirable. The material to be treated need not be a conductor of electricity, and the temperature of the furnace can be controlled by regulating the current.

High Temperatures Obtainable.

In his paper, the author stated that he had discovered a material of which the furnace walls might be made, and which has sixteen times the resistivity of carbon when hot, and twenty-five times its resistivity when cold. He surrounds his furnace with a jacket of refractory material which is also a poor heat conductor, an air space being left between the furnace and its cover. Tests of a small furnace demonstrated that, when heated by means of two vertical electrodes, the temperature reached was about 1,200 degrees centigrade; but when current was passed through the sides of the furnace, the temperature rose to 1,600 degrees centigrade, and could be pushed still higher, as the material does not melt until above 2,000 degrees centigrade.

Pure Oxides Not Conductors.

Some important facts were brought out in the discussion of this paper. It was stated that refractory materials, like metallic oxides, become better conductors as they are more impure; that impurities in the shape of strongly acid oxides are particularly beneficial in promoting conductivity at low temperatures. Dr. Nernst stated that at temperatures of about 1,700 degrees centigrade, pure metallic oxides are non-conductors, but when mixed with other oxides, become conductors at that temperature. Thus, neither pure magnesia nor pure thoria is a conductor when used alone, but a mixture of the two is. This is analogous to the behavior of aqueous solutions, as neither pure water nor a pure sulphuric acid is a good conductor alone, although a mixture is. These observations will, no doubt, have an important bearing on the theory of electrolytic conduction as applied to metallic oxides.

COMMUTATING ALTERNATING-CURRENT MOTORS.

Since the paper describing an alternating-current motor suitable for traction, presented before the American Institute of Electrical Engineers something over a year ago, a number of motors have been constructed by other companies, and tested with a view to determining their practicability for such work. The greater number of these belong to the series type, but we have also the repulsion motor and another type which may be considered as a cross between the series motor and the single-phase induction motor. All of these motors make use of com-

mutators for their operation. Several of them have been tried, not only on experimental tracks, but under actual operating conditions; and in practically all cases favorable reports have been made.

Return to Primitive Type.

It is interesting to note here the return to a primitive type. The first type of alternating-current motors to be put out was the series motor; then the repulsion motor was proposed, this also using a commutator. At that time, motor designers were not able to get rid of the very disastrous sparking, and the development of the beautiful induction machines filled the need for a stationary alternating-current motor, so that neither of the commutator type of motors came to anything, being used only as fan motors for a while and as starting devices. On the other hand, the development of the electric railway concentrated attention on the series direct-current motor, and this type was highly developed. Designers learned how to produce a motor which would run in either direction and under very variable loads, without necessitating shifting of the brushes to prevent sparking. The study of these machines and of other direct-current commutating machines led to an understanding of the cause of the sparking, and the proper means of avoiding it, and the knowledge here gained has now been made use of in converting the old commutating alternating-current motor into a practical machine.

An Analogous Case in Steam Engineering.

We have thus completed a cycle in motor design analogous to that which has been followed in steam engineering. Here the earliest type of steam motor was a turbine, but as then constructed it was naturally extremely wasteful and could hardly be considered a practical machine. Then the reciprocating engine was invented and perfected, and along with it the science of thermodynamics was developed. This science not only showed along what lines the reciprocating engine could be improved, and the limitations of this type, but it has finally carried us back to the primitive type—the steam turbine, which, in principle, is far simpler and which promises a higher efficiency than the highly developed reciprocating engine. It is true that other conditions have influenced both of these developments. Thus, the demand for an electric railway system which can be extended long distances, without requiring substations where constant attendance is necessary, has made the design of an alternating-current traction motor imperative. And as regards the steam turbine, it was not until there was a demand for a prime mover having a high and uniform speed to drive the electric generator that the turbine received the study it deserved and was brought to a practical point. It is interesting to note that the series alternating-current motor, while it loses on some points when compared with the direct-current motor, still is more flexible. A good series alternating-current motor, if provided with the proper controlling apparatus, can be run on the existing direct-current circuit in cities. A minor advantage is that on an alternating-current circuit, voltage control may be adopted and the wasteful rheostatic control avoided.

Cost of the Alternating-Current System.

An important question is, of course, that of the cost of the alternating-current system, as compared with the direct-current. Such a comparison was made recently by Mr. P. M. Lincoln before the electrical section of the Canadian Society of Civil Engineers. His paper appeared in a recent issue of the ELECTRICAL REVIEW. The author reaches the conclusion that, in addition to its other advantages, the alternating-current system would be cheaper than the direct-current system for a road sixty miles long, such as that considered, not only as regards first cost, but with respect to the cost of operation. It therefore seems not unlikely that although the railroad field has been one of the most active of the electrical developments, there will be no falling off in the building of new roads and the electrification of the smaller steam roads.

SITUATION OF THE ELECTRICAL INDUSTRIES.

While there has been a general feeling of uneasiness and much talk of a coming business depression, the indications now are that the electrical industries will not be much affected by these influences during the coming year, if the reported business prospects of the large electrical manufacturing companies have any significance. Thus, at a recent meeting of the district managers of one of the leading companies, encouraging reports were made. Out of nineteen managers present, whose districts cover all parts of the country, eight managers from the Central West, Pacific Coast and the South, reported that their sales for the year 1904 would be considerably larger than during the year just closing; nine managers from New England and New York, declared that their business would be fully as large as during 1903; and but two managers—and these representing unimportant districts—reported that business was likely to be smaller during the next year than it had been this year. These reports are based upon carefully gathered information, and are, doubtless, to be relied upon. It is also reported that another of the leading electrical manufacturing companies expects its business during the coming year to be fully as large as it was during that just closing.

Prospect for Coming Year Good.

It may properly be inferred from these reports that the business of other electrical manufacturers and supply companies will also show no falling off during 1904. It would seem, therefore, that the business depression which was so much dreaded a short while ago, is, at any rate, not likely materially to affect the electrical industries. While there may be a temporary depression in certain sections, due to the present financial condition, this will have little or no effect upon the total amount of work done during the year. There is a good deal of work which must be done to meet the increasing demands of consumers and to improve public utilities which depend upon electricity, such as the telephone, electric light and electric railways. Other lines of electrical application are also becoming important and, in some cases, essential. In fact, electrical methods are so closely identified with improvements and advances in nearly all other industries, that, though the electrical industry itself may suffer temporarily in some lines, on the whole it must advance.

The Exchange of the Frontier Telephone Company, Buffalo, N. Y.

By Virgil Hayden.

THE Frontier Telephone Company, of Buffalo, N. Y., was granted a franchise to construct a telephone system in the city of Buffalo on December 13, 1901. Under this franchise the telephone company was required to furnish the city with 100 telephones free of charge and also pay the city three per cent of its gross receipts annually. A guaranty, protected by a bond, was given requiring the company to maintain competition with the Bell system during the life of the franchise or forty years. Service rates were fixed as follows: $48, $40, $36 and $24 for direct line, two, three and four-party business lines, respectively, and $36, $24, $20 and $15 for direct line, two, three and four-party residence lines, respectively. These rates are for unlimited service.

It was during the month of February, in the year 1902, that the plans for the necessary construction work were started. A complete common battery exchange of 35,000 lines was taken as a basis and the office building site, which corresponded closely to the theoretical telephone centre, was located at 332 Ellicott street.

The building is built of stone and brick and has a frontage of sixty-five feet and a depth of 132 feet. There are three stories. The offices are located on the main floor, stock and storage rooms being at the rear and in the basement. The operating rooms are on the second and third floors at the rear, the front of the second floor being used for a terminal and wire chief's room as well as a storage battery room. The kitchen, hospital, locker, recreation and dining rooms are situated in front of the operating room on the third floor.

The present switchboard, which is of the common battery cutoff relay type, is located on the second floor and is in the shape of a U, the third floor above being in reserve for future growth and is merely a gallery to the second floor, light being furnished by windows at the side and a skylight in the roof. Twenty-three sections, three positions and ten panels to a section of the switchboard have been installed. The answering-jack capacity per position is 160 and the multiple-jack capacity of the board is 18,000. The complete switchboard will consist of fifty-six sections. The finish is mahogany and each section five feet seven and one-half inches long and seven feet high. The present multiple-jack equipment is for 8,000 lines. Numbered lamp caps are used in front of the line lamps and each line lamp is immediately below its corresponding answering-jack. The multiple and answering-jacks are of the two-point type with a cutoff relay bridged from the sleeve side to ground. The usual numbering of stile strips and jacks is used in addition to the numbered lamp caps. The first position is used as a wire chief's test position, the second and third positions as toll trunk positions, the fourth position as a private branch exchange for the company, and the remaining positions as regular subscribers' positions. Each position is equipped with fifteen pairs of plugs and cords with double supervision and individual listening and four-party line ringing keys, also with a suitable number of order wire buttons. The key-shelf of this board is on the slant to enable the operation to be as close as possible to the face of the board. Breast transmitters, with the usual head band and watchcase ear receiver, are used. Each position is lighted by an incandescent electric light in addition to the electric lights placed on columns about the room.

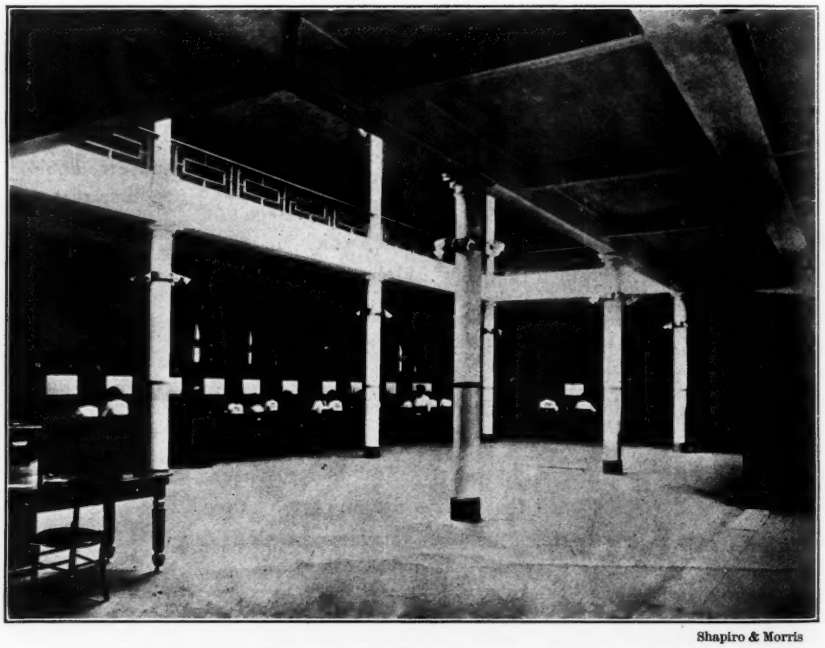
Shapiro & Morris

EX-SENATOR H. H. PERSONS, VICE-PRESIDENT AND GENERAL MANAGER FRONTIER TELEPHONE COMPANY.

A two-position chief operators' desk with the usual equipment is situated in the front of the room and in such a position that the monitors can have full supervision of the operators.

An information desk with four positions is located in a room adjoining the main operating room. Here are kept records of all subscribers and all questions are answered from this desk.

The supervisory relays and all condensers are located in the rear of the board and here are also suitable runways for the various connecting cables. The answering-jacks and line lamps are cabled directly to the answering-jack side of the intermediate distributing frame which is situated in the terminal room, and the multiple-jacks are cabled directly to the opposite side of this same frame. The intermediate frame has forty-triple lug-connecting strips arranged vertically. The relay rack is cabled directly to the multiple-jack side of the intermediate frame



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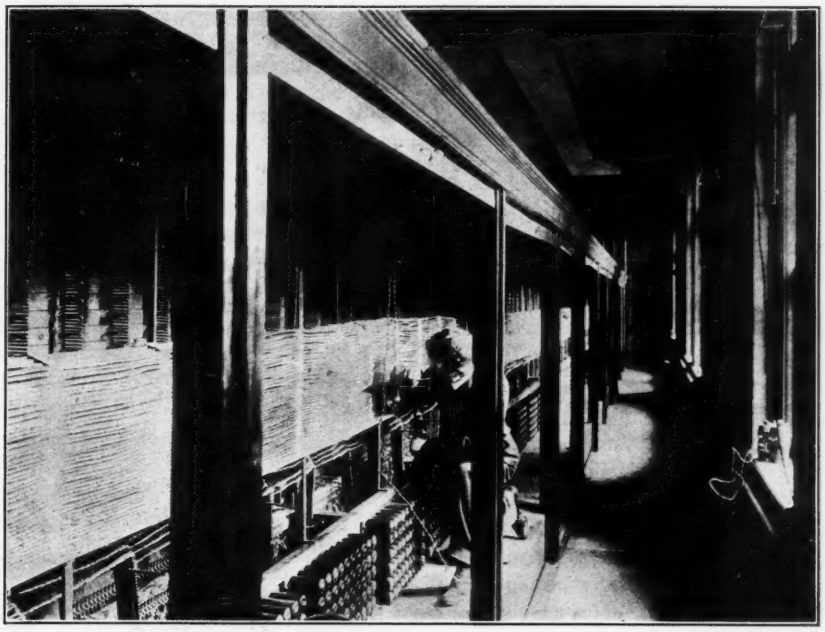
SWITCHBOARDS, FRONTIER TELEPHONE COMPANY, BUFFALO, N. Y.

and the relays, a cutoff and line relay being mounted in the same case, are arranged in bays. This rack is located just to the rear of the intermediate frame. The switchboard side of the main frame is cabled directly to the relay rack. The switchboard side of the main frame is made up of fifty-pair lug-connecting strips arranged vertically. On the opposite side of the main frame are located the heat coils and lightning arresters, and here enter the outside cables. The usual method of running jumpers is used both at the main frame and the intermediate frame. The frames are made up of angle iron entirely.

The power plant is also located in the terminal room and consists of the following: a three-panel power-board, with a three-volt scale voltmeter, individual battery-reading switches, motor switches and starting rheostats on the first panel; on the second panel is a fifty-volt scale voltmeter and fuse panels for trunks, line lamps, line relays, answering cords, answering supervisaries, and transmitters; on the third panel are a 250-ampere scale ammeter, battery charging switches and circuit-breakers. Two ten-horse-power motor-generators for charging the storage batteries, the motors being of the Holtzer-Cabot make, as are all the machines, and type MP four-pole and running off the 220-volt direct-current circuit, taking thirty-eight amperes at a speed of 900 revolutions per minute. The generators are of the type MP four-pole and deliver 175 amperes at thirty volts and at a speed of 900 revolutions per minute. Two four-party line ringing machines with motor in centre and two ringing generators on either end and on the same shaft, one machine to run off the 220-volt direct-current circuit and the other to run off the twenty-four-volt storage battery. The motors are of the type MP four-pole and at a speed of 1,000 revolutions per minute, the 220-volt motor draws four amperes and the twenty-four-volt motor draws 36.5 amperes. The four ringing generators on the one machine are duplicates of those on the other and are of the type MR and will deliver 1.5 amperes at 100 volts. The No. 4 generator has two poles and delivers a current of 16.6 cycles; the No. 1 generator is four-pole and delivers a current of 33.3 cycles; the No. 2 generator is six-pole and delivers a current of fifty cycles; the No. 3 generator is eight-pole and delivers a current of 66.6 cycles. By the use of these different frequency ringing machines and ringers having armatures differently tuned any one of four bells can be rung on a metallic line without the other bells on the same line being disturbed. Each of the four ringing buttons with each calling plug corresponds with the ringing current of the proper frequency. A ten-horse-power Westinghouse twin-cylinder gas engine connected by a chain drive to a charging generator of the same type as those used on the charging motor-generators. Two sets of eleven cells of the National Battery Company's storage batteries placed in a room just to the rear of the charging machines. Each cell at present contains nine plates fifteen and one-half inches square and has a capacity of 600 ampere-hours. The capacity of each cell can be doubled by addition of more plates for which there is ample room in the present tanks.

The Niagara Falls power is used both for power and lighting and is supplied by the Buffalo General Electric Company after being transformed to a three-wire 220-volt direct-current circuit. A gas en-



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BEHIND THE BOARD, FRONTIER TELEPHONE COMPANY.

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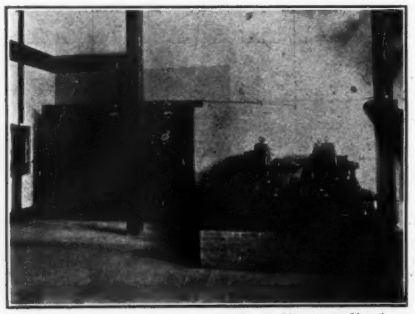
WIRE CHIEF'S DEPARTMENT, SHOWING MAIN AND INTERMEDIATE DISTRIBUTING BOARDS, RELAY RACKS AND CABINET FOR UNDERGROUND CONDUCTORS, 24,000 PAIRS, FRONTIER TELEPHONE COMPANY.

gine is now being installed in the basement to drive an eight and one-quarter kilowatt Crocker-Wheeler generator for lighting purposes, in case the Falls power is shut off at any time.

A two-position wire chief's desk is installed in the front of the terminal room and has voltmeters and all necessary switches for testing out subscribers' lines.



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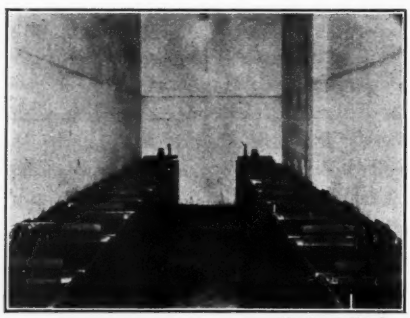
WIRE CHIEF'S DEPARTMENT, POWER SWITCHBOARD AND RINGING AND BATTERY CHARGING GENERATORS, FRONTIER TELEPHONE COMPANY.

The Kellogg Switchboard and Supply Company, of Chicago, furnished and installed the apparatus above described, as did it also furnish the subscribers' instruments which are of the usual type aside from the party line instruments which differ only in the ringer mechanism.

The principal part of the city is fed by an underground cable distribution and there are some thirty-five miles of main conduit trench and over a million feet of conduit ducts. In the business section a main line of ducts leads from the exchange north and south along Ellicott street and from these main ducts and crossing at right angles lead branch ducts on alternate streets, thus touching each block on at least one side. From these ducts, where buildings adjoin each other, lead laterals into basements and office buildings, where basement and office building cable boxes are placed, three or four terminals being placed in each block, and in office buildings from one to four terminals are placed on each floor. In places where the buildings are more scattered, laterals run to poles in the backyards where terminal boxes are placed. In the more compact residence districts conduits are run along the principal streets and laterals are run from these to terminal poles in the backyards. Sometimes in long blocks a pole line is built and aerial cable strung in the backyards or an alley, alternate poles which are several feet higher than the standard being used for terminal poles. Ringtop distribution is used on these poles. In the more scattered residence districts pole lines have been built in the streets and aerial cable strung, terminal boxes being placed quite close together. Idaho cedar has been used for poles throughout the city.



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STORAGE BATTERY ROOM, SMALL CELLS ARE ON TELEGRAPH CIRCUITS, FRONTIER TELEPHONE COMPANY.

Several toll line leads have been built and long-distance communication already established with Rochester and the East as well as surrounding towns. Other toll lines are now being built.

For underground work 400-pair No. 22 B. & S. gauge paper lead-sheathed cables are used which are brought from various distributing centres to the exchange. Here they are brought through the basement and up ducts at the side of the building to a point just below the second floor and underneath the main frame, where four 100-pair No. 22 B. & S. gauge, double silk and single cotton, insulated lead-sheathed cables are spliced into each 400-pair cable. These 100-pair cables are brought up to the cable side of the main frame and there fanned out and soldered to the proper line clips. At various manholes branch cables are spliced into the main cables, and these are used for distribution to buildings and terminal poles. In underground work cables of 400, 200, 100, 50 and 25 pairs are used, but in aerial work only cables of fifty and twenty-five pairs are used.

On pole lines where arms are used, the use of more than two arms to a pole is prohibited. When it is necessary to increase the line capacity, cable is strung and more pole terminal boxes placed. This has been found to present a much neater appearance as well as to be far more convenient.

In running open aerial lines bare copper wire is used, except in sections where trees are encountered and here No. 14 B. W. G. weatherproof iron wire is used. For subscribers' drops single No. 14 B. W. G. weatherproof iron wire is used and placed on glass insulators screwed to two-point universal irons instead of wood brackets. Where lightning arresters are necessary at the subscribers' station an outside arrester is placed near the point of entrance to the building. Pencil fuses are also used at this point. Fuses and arresters are placed at each terminal pole.

All inside wiring is done according to specifications, and differs but little from the usual standards used elsewhere.

Although the Frontier Telephone Company only began cutting lines into service in February of this year, it now has over 6,000 subscribers connected to the exchange. Over thirty private branch exchanges have already been installed, varying in size from 5 to 150 lines each. Also many special equipment private lines have been installed.

Shapiro & Morris

INSTRUMENT REPAIR SHOP, FRONTIER TELEPHONE COMPANY.

The complete installation of the system has been under the personal supervision of Wilbur H. Johnston, superintendent and assistant general manager of the company.

The officers of the company are: president, E. C. Lufkin; vice-president and general manager, the Hon. Henry H. Persons; secretary and treasurer, Charles B. Hill; assistant general manager, Wilbur H. Johnston.

The directors are as follows: Irving Stearns, Henry H. Persons, John B. Weber, H. D. Kirkover, Alvan Markle, E. C. Lufkin, Arthur Scranton, Charles B. Hill, W. A. Douglas, James M. Thomas, Charles E. Austin, Martin Carey, F. R. Green and Charles W. Goodyear.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—IV.

NOTES ON PROGRESS IN EUROPE AND AMERICA.

BY JOHN B. C. KERSHAW.

Electrolytic Chlorates.

The industrial situation in the electrolytic chlorate industry was so fully dealt with in the special illustrated article contributed by the writer to the ELECTRICAL REVIEW on October 4 and 11, 1902, that little can be added to the information there given. A letter giving some interesting dates relating to the development of the industry in Switzerland and France has, however, recently been received from M. Gall, who, with M. Montlaur, acted as pioneer in this industry. The Gall and Montlaur process was first tried on an industrial scale at Villers-St.-Sepulchre in 1886; and this factory was operated until 1891. The Valorbes factory was started in 1890, and the St. Michel factory in 1892, and both of these factories are still in operation. The writer has also recently received a letter from the director of the Vereinigte Chem. Fabriken zu Leopoldschall in which it is stated that although this company carried out experiments upon the electrolytic production of chlorates, and patented a cell and process in the names of Spilker and Loewe, the same was not developed industrially, and the Leopoldschall company is not now producing chlorates by electrolysis. The patents of Spilker and Loewe for chlorate production are dated 1887, 1888 and 1892 while those of MM. Gall and Montlaur are dated 1886 and 1894.

As evidence that the fall in the price of potassium chlorate which is now selling at twopence three farthings per pound in England, as compared with sixpence per pound only twelve years ago, has seriously affected the prosperity of some of the electrolytic works, we have the lack of expansion shown by this branch of electrochemical industry. No new chlorate works have now been erected for four years; and the factory built at Niagara for operation of the Blumenberg process in 1896 has not been restarted, since the fire which occurred there three years ago. As pointed out by the writer in the note on this industry published in the ELECTRICAL REVIEW of February 7, 1903, the electrolytic chlorate industry has been suffering from overproduction and low prices; and only those factories which are working good processes under very scientific management can make profits under the existing market conditions for their product. At present there seems no hope of any marked change for the better in the selling price of chlorates.

Zinc.

The electrolytic or electrothermal extraction of zinc from its ores has lately been receiving much attention, and several important communications to the technical press have recently been made on this subject. Swinburne in a paper read before the Faraday Society (the new English society of electrochemists) has given further details of the experimental trials at Weston Point with the Swinburne-Ashcroft process of extraction. This process is one of chlorination, followed by chemical or electrolytic separation of the various metals contained in the fused mixture of chlorides obtained from the first operation. The zinc is recovered by electrolysis of the fused zinc chloride. The inventors have great faith in the future of their process for treating mixed sulphide ores, and the slow course of its industrial development is perhaps a feature that is to be commended. Electrochemical and electrometallurgical processes that are developed too quickly are apt to collapse with startling rapidity. (See note in ELECTRICAL REVIEW of February 14, 1903). It is now nearly six years since the Swinburne-Ashcroft process was first subjected to laboratory trial; and the scientific data and experience that must have been gained in the trials during this period have no doubt yielded most valuable insight into the practical conduct of the process.

In France, the Salgués process for treatment of zinc ores in the electric furnace is being tried at the carbide works at Crampagna, in the Pyrenees. The ores used for this process contain the zinc, either as oxide or sulphide, and are smelted with fluxes, which yield a slag carrying all the impurities of the ore. This sounds well on paper, but may be difficult in actual practice. The zinc may either be obtained as metal, adhering to the slag, or it may be volatilized and condensed as zinc dust. With ores containing forty per cent of Zn, and furnaces of 100-kilowatt capacity, the output of Zn is reported to be nearly five kilogrammes per kilowatt-day. At present the process is being used at Crampagna for production of zinc-white (blanc de zinc); but it is not stated how this compound is obtained from the zinc dust or metallic zinc.

Strzoda has recently published some instructions for obtaining good cathode deposits of zinc by electrolysis. He advocates the use of sodium zincate solution, with agitation of sand, or other inert finely divided material in the electrolyte to prevent the formation of zinc sponge. The zinc can also be extracted from calamine by this process, if the ore be first crushed and suspended in the electrolyte. In both cases carbon anodes are used, with copper as cathode material.

Barium and Its Compounds.

Some details were given in the ELECTRICAL REVIEW of February 28, 1903, concerning the production of barium hydrate at Niagara Falls, by the Bradley & Jacob's process. This process depends upon the treatment in the electric furnace of a mixture of barium sulphate and coke, portion of the sulphate being first reduced to sulphide, and the two salts then reacting at the temperature employed to yield oxide and sulphurous acid gas, in accordance with the equation—

$$3BaSO_4 + BaS = 4BaO + 4SO_2$$

The writer pointed out in the note referred to above, that this reaction could be carried out in ordinary furnaces heated with coal, and that only in exceptional cases could electrical energy be profitably utilized for this manufacture. The conditions for success, were stated to be: cheap power, and a market for the products in the vicinity of the works. These conditions do not appear to have been found at Niagara, for the United Barium Company is stated to be in liquidation, and a deficiency of $30,000 exists in the accounts; the assets being valued at $90,000 and the liabilities being $120,000. The collapse of this company comes rather as a surprise, for as recently as the autumn of last year, it was stated that the manufacture was a success and that the factory at Niagara was to be greatly extended. The cause of the failure is said to have been the small demand for barium hydrate in the sugar industry in the United States; and possibly the objection to use barium salts (which are all poisonous) in the preparation of a foodstuff, may have had some influence upon the result. In England, this objection to the use of barium salts for sugar refining is very much in evidence.

As regards the other process, to which reference was made in the earlier note, the writer has recently received a further communication from the agent of the Brussels firm which is exploiting the patents. In this, it is stated that the plant at Brussels is only an experimental one; that the process has been improved, and that it is now worked without the aid of an electric current. Barium and its salts must therefore be removed from the list of chemicals now being produced industrially by aid of electricity.

MOUNTAIN CLIMBING RAILWAYS.

BY GEORGE E. WALSH.

The opening this winter of the new electric railway which is to climb to the summit of the Jungfrau practically inaugurates a new era in mountain climbing railroading. Some of the most difficult engineering problems in railroading of the past have been overcome in constructing railroads to the summits of famous mountain peaks to accommodate the summer visitors who wish to ascend to the high altitudes for their health or pleasure. The most noted of these railroads in this country are those which wind up the sides of Mount Washington and Pike's Peak.

The Mount Washington railroad is the pioneer mountain climbing railroad of this country, and for upward of a quarter of a century it has been one of the famous attractions of the summer resorts of New England. The Pike's Peak railroad reaches a higher altitude than that of the former, and it required greater engineering difficulties to construct it. During a good part of the time the construction engineers were forced to cut their way through solid rock in the face of heavy snowstorms. The grades of both roads are steep at places, and the cost of operating the two lines has made their financial success much lower than the builders expected. The railroad up Mount Pilatus represented the most important mountain climbing railroad in Europe until the new Jungfrau railway was projected and opened to the public.

The equipment of the mountain railroads with electric power was experimented with a dozen years ago, but little success attended these efforts. Electrical railway developments have within the past few years brought the matter up again for consideration. The question of changing the motive power of the two important American mountain climbing railroads to electricity is now in the charge of engineers, who in the past year have been making estimates on the cost of installation and operation.

The Jungfrau railway offered in every respect most difficult electrical engineering features that had to be overcome in order to demonstrate the feasibility of climbing mountains by electric cars. The Eigerwand station of the Jungfrau, which has just been opened, is the highest point of any electric railway in the world. The total height of the mountain to its accessible summit is 13,670 feet, and to this extreme altitude it is proposed to carry the new road if possible. The early projectors of the railway did not anticipate reaching the summit, but merely to connect some of the few important lower levels with Scheidegg, where the steam railroad running from Lauterbrunnen and Grindewald ended. This is the highest point of the western Alp level of this district, and is 6,160 feet above the sea level. To start at this altitude and run an electric railway to the summit of the Jungfrau was a daring undertaking.

From this starting point the engineers ran the line to the Eiger glacier, which has an altitude of 7,645 feet, where a magnificent view of the mountain and valley is obtained. To complete this first part of the road a tunnel 322 feet long had to be cut through the solid mountain. There is probably no station in the world which affords such an extensive view of glaciers as this electric railway station at Eiger. Although the altitude of the station is only 873 feet higher than the starting point of the road, it requires a ride of a mile and a quarter to reach it, so winding and irregular is the route.

The first section of the road proved so popular to tourists that work was immediately begun on the second section, which extends to Rothstock, and enjoys an altitude of 8,270 feet, and is two miles from the starting point. The third station was established at Eigerwand, and is 9,405 feet altitude. The fourth station is Eismeer, or sea of ice, with a total altitude of 10,355 feet. This station is completed, and the line to this point is nearly ready for operation.

From this point the line will run in time to Jungfraujoch, 11,090 feet, and eventually to Jungfrau, a total height of 13,488 feet. This is as close to the summit as any line can come, but the remaining few feet will not count. A winding staircase or an electric elevator may eventually be built to carry those who wish to reach the very pinnacle of the mountain peak.

To reach this great altitude with an electric railway, the engineers were forced to cut their way through the solid mountain rocks for nearly one-half the distance. There was no side spurs or galleries over which the road could be built. Through different portions of the tunnels windows have been cut to give the passengers views of the valleys and mountain peaks.

The difficulties experienced in cutting through the mountain at several points was so great that only electrical drills and boring machines could be used. These had to be chained to the sloping sides of the mountain, while the workmen were lashed to suspended platforms from above. The electric boring machines were worked by American-made motors, and when the section beyond the present highest station is started even more difficult engineering feats will be required to place the machines in working position. The line of eternal snow and ice will then be reached, and the work must be carried on under difficulties of the most surprising kind. Frequent snowstorms and blizzards enshroud the summit of the mountain, and it is expected that work can be conducted only in summer time.

The gradient of the new road in its first four sections runs from fifteen to twenty-five per cent, but this maximum may be further increased in the final stretch. Another obstacle in the way of the engineers was that of securing proper workmen who could toil in such rarefied atmosphere. At 10,000 feet altitude comparatively few workmen can do hard work for more than a few hours a day; but the selected north of Italy men appear able to respond to the demands of the climate better than was expected. Mountain sickness frequently decimates the ranks of the workmen, and new shifts have to be obtained from below; but these new men have to be accustomed to the high altitudes by degrees. At 13,000 feet, the workmen may have to work in shifts of two hours at a time, and then return to lower levels for rest and recuperation.

The company constructing the road give the best hygienic care to their workmen, and they are housed and fed with as much attention to little details of comfort as though they were a part of the company's board of directors. As the road is pushed skyward a completely equipped plant goes with the men, including a bakery, smithy, infirmary, and good houses for sleeping and eating. It has been found, however, that many of the rugged mountaineers can not only live at the summit of the Jungfrau all the time, but they maintain an amount of health and strength that is surprising to those who have heretofore concluded that an altitude above 10,000 feet was destructive to the tissues of the heart and lungs.

The gauge of this new mountain climbing electrical railway is thirty-nine inches, and the rails weigh forty-two pounds to the yard. They are laid on sleepers of steel, to which they are bolted and clamped securely. As the rack system is used, the rails have teeth cut into them. The electric locomotives employed for the new railway are built so that the working parts will be amply protected from extreme weather conditions, being enclosed

so that all parts can be kept warm. They are operated by two three-phase motors of either the Brown, Boveri or Oerlikon type. These have from 120 to 150 horse-power, with 750 revolutions per minute.

The motive power for operating the road is obtained from the waterfalls on the White Lutschine, a distance of nearly six miles from the nearest railway station. The power for the road can be increased at comparatively little expense. The three sets of turbines can furnish 2,650 horse-power; but at present only about 1,650 horse-power is installed. There are two Girard turbines of 500 horse-power each; two Francis turbines of 800 horse-power each, and two small auxiliary turbines of twenty-five horse-power each. These six turbines are directly coupled to three-phase alternators which generate 7,000 volts. The electric current is carried to the substations in conduits of pipes made of steel sheeting, and the high pressure transformed in 200-kilowatt transformers. At the stations small transformers take the high-pressure current down for lighting and heating purposes.

The wooden poles for carrying the transmission line are placed 100 feet apart where topographical conditions will permit, but through the tunnels the wires are attached to wooden side brackets, or carried through conduits built for them in the solid rock. The construction of the supports for the transmission wires was as much a problem in places as that of building a place for the track. In fact, at almost every step of the way some unique engineering obstacle had to be overcome.

Four trolley poles collect the current, two for each phase. The brake on the engine and cars was of necessity important, and this is applied by the tension of a strong spring resting on the axles of the motors. The trains are made up of a small locomotive and two trailers coupled on behind. Complete this train weighs about twenty-eight tons, and the two trailers will accommodate eighty passengers. The speed of the train is not great, nor is it desirable that it should be, as passengers ascending the mountain frequently desire to study the scenery at different points as they advance. It is intended that the trip up to the summit shall consume about one hour and forty minutes. This gives the passengers the opportunity to accustom themselves to the change of atmosphere. A sudden rise to the top of such a mountain is dangerous to many people, but with a slow rise it is estimated that not one per cent of tourists will be unpleasantly affected by the air. The train runs on the maximum gradients of twenty-five per cent at a speed of 8.5 kilometres per hour, but even this speed will not be maintained at all seasons of the year. Those suffering from mountain sickness can be let off at almost any place along the line where medical attendance can be obtained.

In the winter season it will probably be impossible to run the cars on account of the severe snowstorms, and the road will practically be snowbound and the summit station cut off from the rest of the world from October to April. There will, however, be maintained at the summit all the year round a small colony of workmen, including electricians, engineers, hotel-keepers and physicians. Ample accommodations will be provided for them in the way of shelter and refreshments. Many mountain climbers visit the summit in the dead of winter, and those who follow the line of the new road will be sure to find shelter and food at the different stations.

Unique in the annals of railroading as this line will be, the cost of operation is placed so much lower than that required to run cars up and down Mount Washington, Pike's Peak and Mount Pilatus, that the enterprise is assured of success at the beginning. It practically opens a new era in mountain climbing railroads. There are a dozen mountains in this country where similar electrical roads will be built with advantage to tourists seeking health and recreation. The wonderful curative effects of mountain air at certain seasons of the year is spreading the demand for accommodations at high altitudes. The question of reaching the summits of the mountains has always been the most insurmountable obstacle, and the experiments with steam railroads and cable roads have not been altogether satisfactory. Electricity in entering this new field of endeavor may soon convert our mountain summits into great health resorts and sanatoriums.

Anniversary of the Death of William Gilbert.

Thursday, December 10, was the three hundredth anniversary of the death of William Gilbert. In commemoration of this, the mayor and other representatives of the borough of Colchester, England, attended a meeting of the British Institution of Electrical Engineers, and received, on behalf of the borough, an historical picture representing Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth and her court. William Gilbert was born in the borough of Colchester in 1544, and died in 1603.

An Electric Baker's Oven.

An electrically heated oven for a bakery has been put in service at Montauban, France. This draws its power from the local distributing system, and the oven has not been changed in carrying out the installation. In case of an interruption to the electrical supply, it can be heated with wood. The oven is circular, 3.2 metres in diameter, with a spherical arched roof fifty centimetres maximum height. It is completely enclosed, with no other opening except the oven door.

The electrical installation consists of twenty heating elements using 700 watts each. They are connected in parallel across the 110-volt circuit and are distributed in four hearths—two taking 37.5 amperes at the centre, and two twenty-five amperes at the sides, a total of 125 amperes. The heating elements are placed on a rack, and can be raised or lowered in the oven, as desired. It is raised when introducing the bread and lowered toward the end of the baking, with two hearths operating simultaneously at a rate of 125 amperes, 110 volts, a consumption of 13.75 kilowatts; the desired temperature is reached in ninety minutes, the energy consumed being 20.625 kilowatt-hours. After this point has been reached, the power required is reduced to 5.5 kilowatts and the bread is introduced. The baking is then continued without interruption.

The Pacific Coast Electric Transmission Association.

The transactions of the Pacific Coast Electric Transmission Association, just issued, contain the proceedings of the seventh annual convention, held in San Rafael, Cal., June, 1903. The following is a list of the papers which were read and discussed: "After the Ions—What?" by Alexander G. McAdie; "The Electric Automobile as an Income Producer," A. E. Brooke Ridley; "Electric Power for Mining Purposes," George Scarfe; "A Coming Problem for the Pacific Coast Engineer," W. F. Lamme; "Local Distribution for Transmitted Power," George C. Holberton; "Single-Phase Motors for Multi-Phase Plants," H. A. Bullard; "Organization of the Operative Forces of a Transmission Plant," L. M. Hancock; "Some Notes on Alternating and Direct-Current Arcs," P. C. Butte; "Electric Railway Service as Supplied by Long-Distance Power Transmission," Allen H. Babcock; "Tangential Water-Wheel Efficiencies," George J. Henry, Jr.

New York Electrical Society.

The New York Electrical Society held a most interesting meeting on the evening of December 16, when Mr. S. T. Dodd, of the Stanley Electric and Manufacturing Company, of Pittsfield, Mass., gave a comprehensive lecture on "The Evolution of the Electric Railway Motor." Mr. Dodd said:

The early investigators of the electric railway problem, Edison, Field and others, made the mistake of attacking it from the locomotive standpoint and consequently their efforts contributed little or nothing to the solution of the problem. The first electric car to be driven by a motor placed under the car floor was put into operation in 1884 in Cleveland, Ohio, by the Bentley-Knight company.

In '85 and '86 various experiments were made by Messrs. Daft, Sprague, Vanderpool and Short. Mr. Short attempted to develop a series railway system and built a road in Denver which was soon abandoned. To Mr. Short should be given the credit of seeing that for motors of the normal speed of that date, double-reduction spur gearing should be used. By '87 or '88 both the Bentley-Knight and the Sprague companies had developed bipolar, series-wound motors, especially for railway service, and it was about this time also that public attention began to be attracted to the work.

The years '88 and '89 were very eventful; the Sprague and Edison interests consolidated, the Bentley-Knight interests were acquired by the Thomson-Houston company, and there appeared on the market a Westinghouse double-reduction motor and a Short double-reduction motor. We might say that the standard railway motor at this date was bipolar, running at a normal speed of 1,000 to 1,500 revolutions per minute. It was connected to the axle by double-reduction gearing, it was series-wound and with the exception of the Short motor was of the smooth core drum type. The high speed of these motors was a serious disadvantage. The railway managers were bitterly complaining of the expense of maintaining gears and pinions. It was seen that the electric railway motor could not be a final and permanent success until some method was found of obviating this difficulty.

The Wenstrom motor of 1890 offered the solution of this difficulty. The Wenstrom motor was a multi-polar designed with slotted armature, thereby making possible the reduction of motor speed and the change to the single-reduction type of motor. The Westinghouse company then introduced what might be called the first of our modern motors, its No. 3, which with the minor modifications introduced in its No. 12 and No. 38 remains to-day the standard Westinghouse type.

The G. E.-800 motor of 1893 was an attempt to make an absolutely enclosed and waterproof motor. With the appearance of the enclosed motor, a new problem was introduced; namely, ventilation, a factor which had previously received but little attention and which even to-day is not always given the consideration which its importance deserves. In 1894 appeared the G. E.-1000, wherein it followed the lead of the Westinghouse No. 3 and had four poles, abandoning the consequent pole design. In 1895 the Walker company brought out its No. 3, which marked a decided advance in that better provision was made for ventilation than in any previous type of motor. In 1899 the Westinghouse No. 38 introduced laminated poles. In 1896 there was a change in the character of the service demanded of railway equipments brought about by the beginning of interurban roads and by the extension of city roads into the suburban districts, the new conditions calling for continuous service at moderate loads. In order to meet the new requirements the General Electric company brought out its No. 52, the feature of which was the ventilated armature which has since become standard. The Walker 15-L, a 100-horse-power motor which was built for the Brooklyn elevated, and the G. E. No. 51 illustrate the limitation imposed upon motors of the standard type when built in large sizes. This limitation called for a change in motor construction which was met by such motors as the G. E. No. 50 and particularly the G. E. No. 55 built for the Nantaskett Beach line and the Metropolitan and Westside elevated. The latter had a solid box frame with waste packed bearings from which the armature could be removed by sliding it out through one end. This type has since become popular for very heavy service.

The S. K. C. type of motor represents a still further development of the principle of motor ventilation. For the first time in a street railway motor, both ends of the armature are left open for the entrance of air into the armature and there are ducts in the pole-pieces and through the frame of the motor which register with the ducts in the armature perpendicular to the shaft. As a result of this unusually good ventilation the all-day load of this motor is about fifty per cent of its hour rating (with the same heating) as compared with an all-day capacity of but thirty-five per cent of the hour rating for other motors of the same grade.

In the G. E. No. 74 motor is preserved the compactness of the G. E. No. 55 with the added advantage of increased accessibility of the armature. The G. E. No. 69 for the New York subway and the two makes of German motors used upon the Berlin-Zossen line are the most modern types of motor for heavy service, and in each of them it should be noted increased attention is being paid to ventilation. As is well known, the Berlin-Zossen motors are alternating-current motors and mark a reversion to the gearless type discarded ten years ago.

I have attempted to show you how our present type of motor grew from the stationary motor of twenty years ago. It is a series motor, a characteristic which it inherited from the Brush motor used by the Bentley-Knight people in 1884. It is hinged upon the axle and geared to it by spur gearing, for which we are indebted to Messrs. Sprague and Short in 1886; it is a multi-polar motor, with slotted armature which is derived from the Wenstrom motor of 1890; it has concentric fields, with salient poles, projecting inwardly from the surrounding case and the armature is series connected so that one pair of brushes suffice for a multi-polar motor, characteristics which are derived from the Westinghouse No. 3 of 1891. It has machine-wound coils and a barrel armature, which are due to a development through the Westinghouse No. 3, the G. E.-800, and the Walker. It has laminated fields, which were introduced by the Westinghouse No. 38 in 1895; it has a ventilated armature for which we are indebted to the G. E. No. 52 of 1896.

At the present time, increased attention is being paid to disposing of the heated air from the interior of the motor and the ventilation of the motor for long-time service. This means that the motors of the future will have reduced weight of electrical parts, magnetic iron and conductors, and more attention will be paid to the bearings, gears and other mechanical parts.

The history of the art was illustrated by an admirable series of lantern slides. The following members were elected: Mr. R. P. Bache, Central Electric Company, Bound Brook, N. J.; Mr. John C. McGibney, 364 West Twenty-fifth street, New York city; Mr. Jas. Stuart Patrich, 125 West 133d street, New York city; Mr. Wm. J. Moore, Stevens Technical Institute, Hoboken, N. J.; Mr. Henry Abbey, Marine Engine and Machine Company, Harrison, N. J.; Mr. Carl Behn, Buffalo Refrigerating Machine Company, Harrison, N. J.

The Edison Portland Cement Company.

A General Description of the Process and the Works at New Village, N. J.

THE works of the Edison Portland Cement Company are located at New Village, N. J., adjacent to the main line of the Delaware, Lackawanna & Western Railroad. The Edison company has some 600 acres of land in and about New Village and Stewartsville, N. J., the greater portion of which contain limestone and cement rock. The buildings stretch out in a continuous line for about a half mile, and a study of the accompanying drawing will give a good idea of the general layout of the plant.

Two cuts have been made into the face of the outcropping—one into the limestone and the other into the cement rock—each cut in at a slight angle to the other. The rock strata is composed of carbonate of lime and cement rock, the carbonate of lime lying next to the dolomite. The Edison company has what is probably one of the most fortunately situated quarries in the world, in that the cement rock found in this territory and the limestone both are of the best quality for the making of good cement.

The accompanying photograph shows a general view of the cutting in the quarry as it stands to-day. The outcropping has been penetrated to a depth of probably 200 yards, and the walls of the quarry are now about fifty feet high.

The rock is first drilled and blasted, and then picked up by a ninety-ton Vulcan steam shovel and loaded upon skips, a standard gauge railway running into the heading in each cut. These ninety-ton steam shovels are the most powerful of their kind ever constructed. Huge boulders weighing upward of five to six tons are easily picked up and deposited upon the skips. After each skip is loaded, it is hauled by a horse to a siding, where a train of flat cars is made up, and the rock is then hauled from the quarry, a distance of nearly a mile, to a shed located about 100 yards from the crusher. It is here that the actual process of cement-making begins.

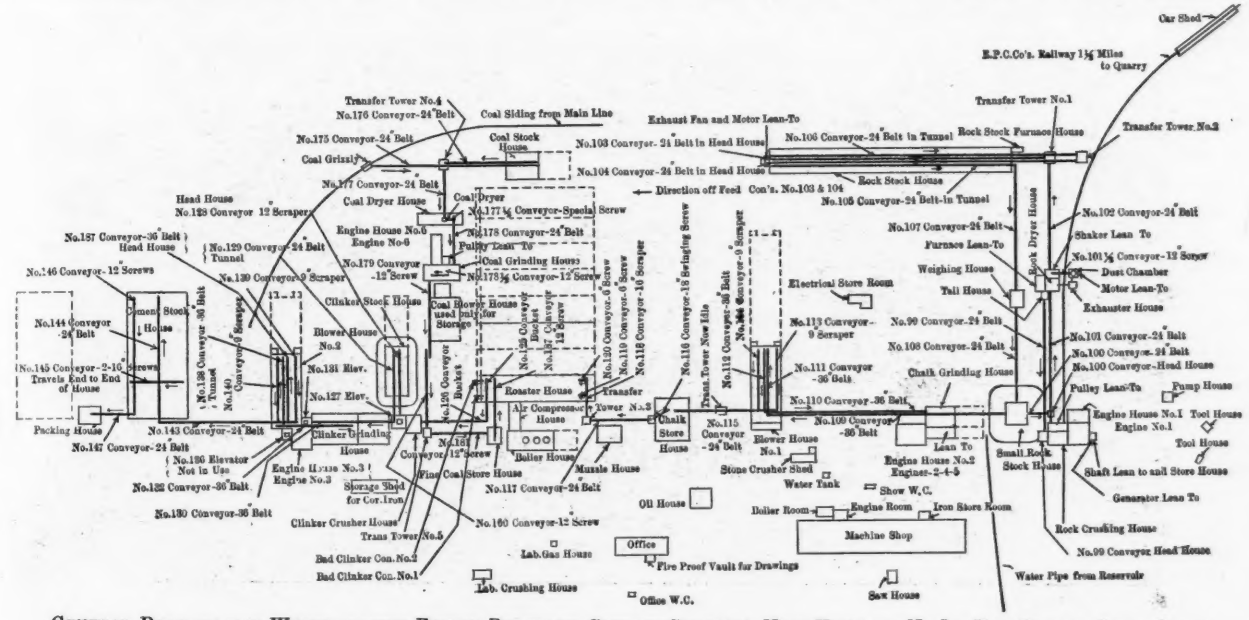
Aside from the roasters, which provide the spectacular element of the plant, the crushers are, of course, the most interesting from a popular and technical point of view. After the locomotive has hauled its train of flat cars to the shed, the train is broken up into sections of three cars apiece. There is a slight decline from the car-shed for about 500 feet, where the bottom of an incline reaching into the crusher house is met. The three cars travel by gravity along the tracks and partly up the incline, where they butt into a "dolly" car, which is provided with an automatic coupler. By means of this car the three flats are then hauled up the incline to the top of the rock-crushing house.

In this rock-crushing house are situated the giant crushing rolls, and beneath these, the smaller rolls for crushing the broken rock. At the top of the rock-crushing house is a very interesting application of the motor drive.

It might be well at this point to explain that the skips are laid loosely upon the flat cars, and are of the form of an exaggerated dustpan. At the back of each is a heavy ring bolt. A large hook on the end of a flat steel belt automatically engages with this ring bolt and drags the skip from off the flat into adjustment at the edge of the hopper just above the giant rolls. These giant rolls are each five feet in diameter by five feet long, and the moving parts weigh, approximately, twenty-five tons each. They are capable of crushing any size of stone weighing five tons or less. The two rolls rotate in opposite directions, and are made up of chilled iron plates fitted on to a mandrel.

The motor which operates the skip dump—as the hook apparatus is termed—is enclosed in a gunny chamber which is absolutely dustproof. This is a chamber which is made up of a skeleton framework, and the housing of which is composed of gunny cloth. It is a feature of all of the electric motors used in the Edison works that they are enclosed entirely in these dustproof gunny chambers, and all of the gears are also enclosed in gear cases, to prevent their being interfered with by the dust which is prevalent in all parts of the mill.

Immediately in front of the hopper,



GENERAL PLAN OF THE WORKS OF THE EDISON PORTLAND CEMENT COMPANY, NEW VILLAGE, N. J.—THE DOTTED LINES SHOW INTENDED EXTENSION.

and directly under the edge of the skip as it is placed in position for dumping, is a feed roll operated by an enclosed electric motor, and which throws the rock directly between the crushing faces of the giant rolls. This feed roll, together with the skip dump and the drum for hoisting the three cars up the incline to the rock-crushing house, is controlled from a platform to one side of the main hopper. On this platform are the two controllers. The cable drum which winds the cable for pulling up the cars to the crusher is operated by a 500-volt, 110-horse-power, General Electric motor. This is equipped with a solenoid brake for lowering the cars, and the resistance is disposed along the roof of the building. The three cars which are brought up at each time contain about fifteen tons, and a trip is made once every four minutes, the crusher taking care of the stone as fast as it can be brought up.

After the rock has been deposited in the hopper and passed through the giant rolls, it drops to a smaller hopper with a capacity of ten tons, and is fed out over a roller feed to the first set of thirty-six-inch rolls on the floor below. Then it passes by gravity through a second and third set of thirty-six-inch rolls. These thirty-six-inch rolls are thirty-six inches in diameter and thirty-six inches long, with a crushing face of twenty-eight inches. The first thirty-six-inch rolls have flywheels to enable them to crush the large pieces passed by the giant rolls. Both the first and second rolls are set rigidly at a fixed distance between the crushing faces, but the third set of thirty-six-inch rolls is held together by a set of coiled springs. This latter set of rolls also receives the spalls from the rock-drying house, which matter will be taken up in detail a little further on.

After passing through the first set of thirty-six-inch rolls, the rock has been broken up into cubes of about three inches cross-section. Passing through the second set; it is broken into pieces of about one-half this dimension; and, on passing through the third, it comes down to about one-half inch in cross-section and finer. From the third set of thirty-six-inch rolls the broken rock passes on to conveyor belt No. 100 to the rock-drying house.

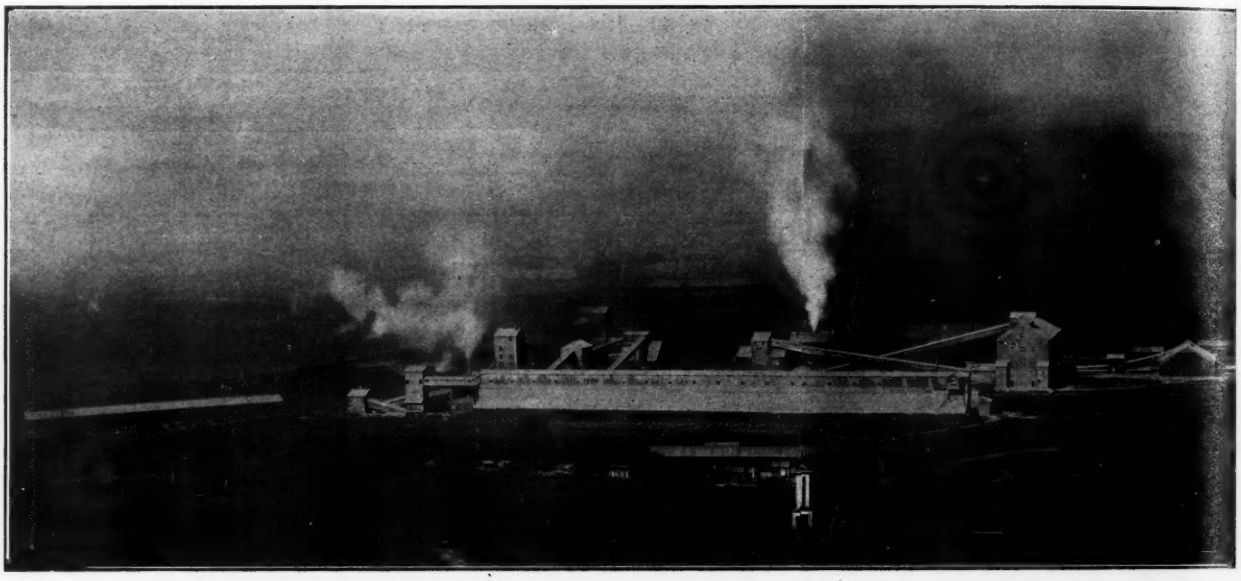
The crushing rolls in the rock-crushing house are driven from the engine room on the first floor by a 500-horse-power E. P. Allis vertical cross-compound condensing engine. This runs at 100 revolutions per minute, and drives directly on a jack-shaft. On this shaft is one pulley with a seven-foot face, upon which are three belts driving the three sets of thirty-six-inch rolls. On the same shaft another pulley drives the giant rolls. Three generators are also driven from a pulley on the same shaft.

The broken rock, after being carried on the conveyor belt from the bottom of the rock-crushing house to the top of the rock-drying house, is allowed to fall by gravity through a series of grates and baffle plates, which are continuously heated by hot gases. On the first floor of the rock-drying house are three furnaces, and the heat enters the drying flues in three places. A shaker engine draws the baffle plates in and out, and allows the broken material to fall through. These furnaces are equipped with blowers for forced draft, when this becomes necessary. After the material has passed through these three stages, the rock has been thoroughly dried.

The hot gases from the furnaces are exhausted from the top of the dryer by an eighty-inch exhauster, and delivered in a dust separator. The dust from the separator is delivered to conveyor belt No. 102, by screw conveyor No. 101½. The rock-drying plant is driven by a fifty-horse-power motor.

After the rock has passed through the drying house it is conveyed by conveyor belt No. 102, to transfer tower No. 1. At transfer tower No. 1 the rock is deposited on conveyor belt No. 103, by which it is taken to the rock stockhouse. This rock stockhouse is 462 feet long and has seven bins, each with a capacity of 1,500 tons. Four of these bins are used for cement rock, and two for carbonate of lime, the extra bin being used for mixing purposes. Belt conveyor No. 104, on the top of the rock stockhouse, and belt conveyor No. 106, on the bottom of the rock stockhouse, are used for mixing only, and the material may be taken from, and delivered to, any of the bins by these two conveyors. This mixing process is necessary for the reason that sometimes the rock, as quarried, runs high in lime, and at other times runs comparatively low. By carrying the cement rock back and forth through transfer tower No. 2, it is thoroughly mixed and ensures a uniform product.

After the material has been thoroughly mixed it is fed out from the different hoppers over a feed roll, and delivered on belt conveyor No. 105, at the bottom of the rock stockhouse, and transferred to

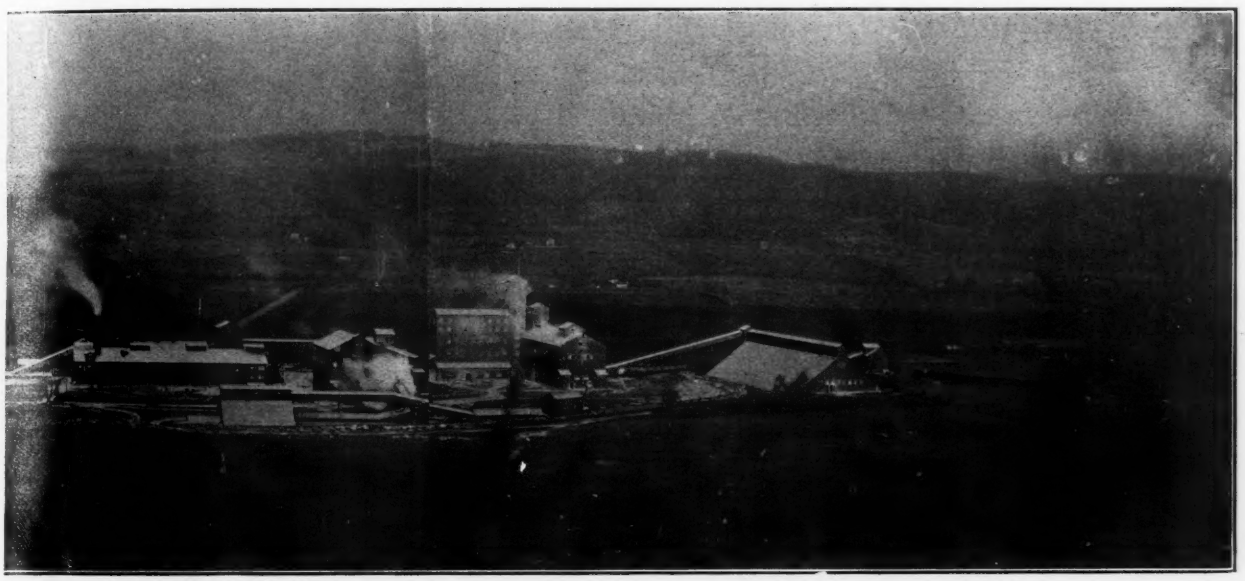


BIRD'S-EYE VIEW OF EDISON PORTLAND CEMENT COMPANY'S PLANT AT NEW VILLAGE, N. J. CRUSHER HOUSE IS AT IN THE BOILER HOUSE AND THE TWO

belt conveyor No. 107. On this belt it is carried to the weighing house. In the top of the weighing house there are two bins, one for limestone and one for cement rock, each having a capacity of sixty tons. From these bins the material, which is up to this point separated, is delivered into weighing bins. This is a very interesting stage in the process. After the chemist has laid out his formulæ for the value of the several elements, a certain proportion of each is delivered to the weighing bins. The scales are set so that, after the proper proportion has been deposited on the weighing pan, the scale beam closes an electrical circuit which cuts off any further supply. The cement rock and limestone, in the proper quantities, are then delivered through chutes going to a feed roll, which mixes them thoroughly, delivering the mixed material to conveyor belt No. 108, this belt, in turn, delivering it to the small rock stockhouse or "bijou." This "bijou" has a capacity of 1,000 tons of material ready for grinding. From this point the mixed material is fed out by a feed roll on belt conveyor No. 109, where it passes under the chalk-grinding rolls and is delivered on belt conveyor No. 111 at the top of blower house No. 1. This conveyor has two "S" dumps, each of which dumps feeds eight blowers. The material, after passing through the blowers, falls through a set of baffle plates, while a current of air is passing through it. The air carries the dust into a large settling chamber, where the dust settles to the bottom on account of the reduced velocity of the air. The air is taken from the top of the bins and returned to the blowers by means of pipes, while the dust is removed from the bins by scraper conveyors Nos. 113 and 114, and delivered on belt conveyor No. 115, which takes it to the chalk stockhouse. The coarser material, which is rejected by the blowers, is carried by chutes to belt conveyor No. 112, which transfers it to belt conveyor No. 110, and this belt takes it back to the feed rolls over the chalk-grinding rolls.

The chalk-grinding rolls are twenty-eight inches in diameter and have an eight-inch face. One roll is driven from a main shaft, and the other two rolls are driven by friction from the direct-driven roll. The pressure between these rolls—which varies from 14,000 to 18,000 pounds per square inch—is obtained by having a set of loose sheaves on the ends of the two outside rolls, with an endless wire rope weaved over them, similar to a block and fall rig. There is a sheave in the bight of this rope which is connected to a cylinder to which compressed air may be admitted at any pressure. By this means there is no pressure on the bearings of the rolls when crushing, except that due to the weight of the rolls themselves.

Adjoining the chalk-grinding house is engine house No. 2. This contains an E. P. Allis vertical cross-compound condensing engine of 750 horse-power, this engine driving the main shaft, which, in turn, drives the chalk-grinding rolls. There are also in this engine room two Armington & Sims horizontal engines of 300 horse-power, each driving lighting generators. In addition to this equipment there is a motor-generator set used as an equalizer. Each of the latter engines has a flywheel on both ends of the shaft, and one engine drives two General Electric direct-current generators at 250 volts, 800 amperes, 425 revolutions per minute. The other engine has a flywheel on each end of the shaft, with two belts on each flywheel, driving one General Electric 250-volt 220-ampere generator, one General Electric 250-volt 260-ampere generator, and two old-style Edison bipolar lighting machines. In this engine room these is a handsome black slate switchboard, equipped with switches, measuring instruments and regulators. The apparatus now installed is temporary, and ultimately will be replaced by a general power station with direct-connected compound engines.

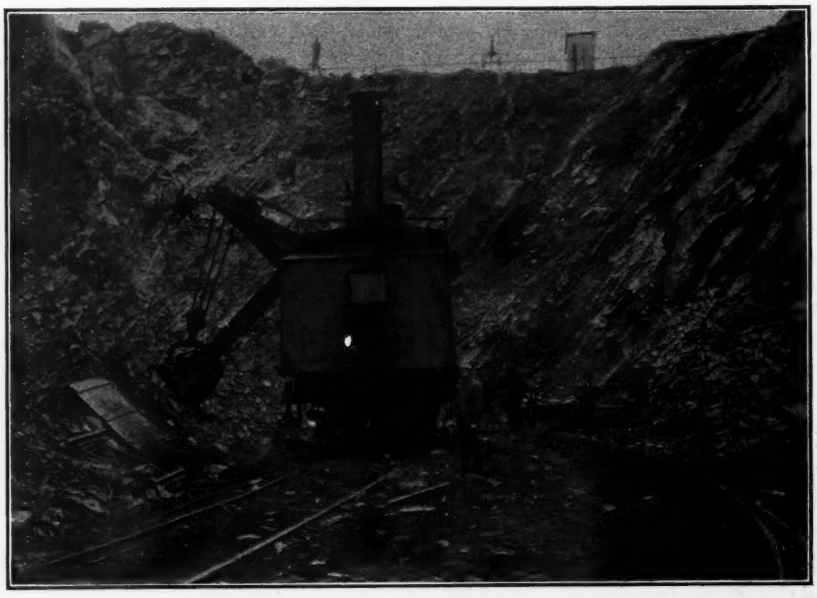


THE LEFT TO THE REAR. THE DIFFERENCE IN DEGREE OF COMBUSTION IS NOTICEABLE IN THE THREE SMOKESTACKS
STACKS IN THE ROASTER HOUSE.

The capacity of the chalk stockhouse is 1,000 tons of material, and this is moved from the building by screw conveyor No. 116. This conveyor is pivoted at one end and travels on a track at the other. It delivers the material to belt conveyor No. 117, which transfers the same to scraper conveyor No. 118, and this conveyor distributes the material into the bins of the roasters.

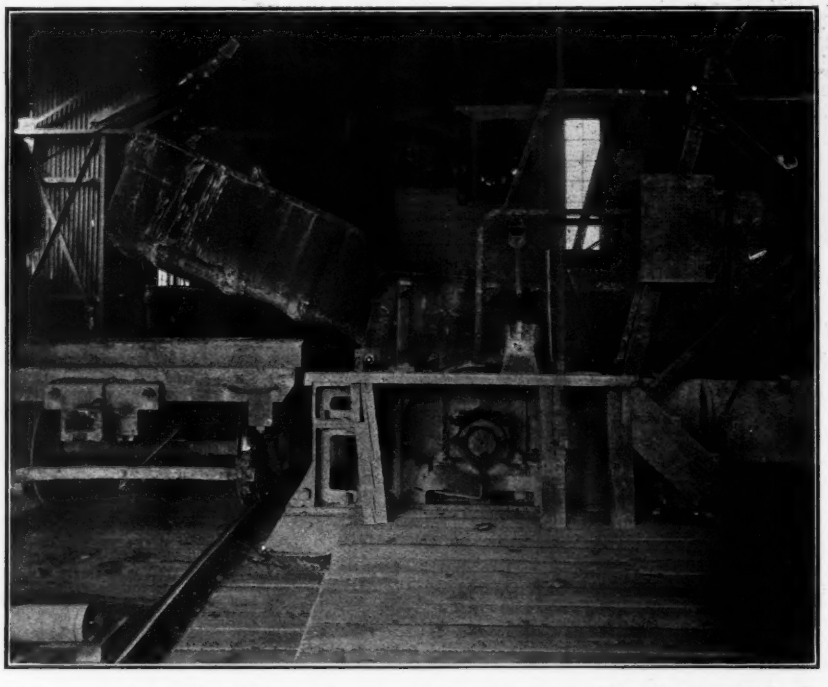
The roasting house is, no doubt, the most interesting part of the whole plant. It is here where there has been carried out one of the most remarkable of engineering feats. The roasters are sectional cast-iron cylindrical shells 150 feet in length. These have an outside diameter of nine feet and an inside diameter of six feet, and are lined with firebrick. Each of the roasters has a capacity of 900 bar-

rels of cement for a day of twenty-four hours. They have a pitch of about four feet in one-hundred, and, as they are revolved, the material works down the slope.



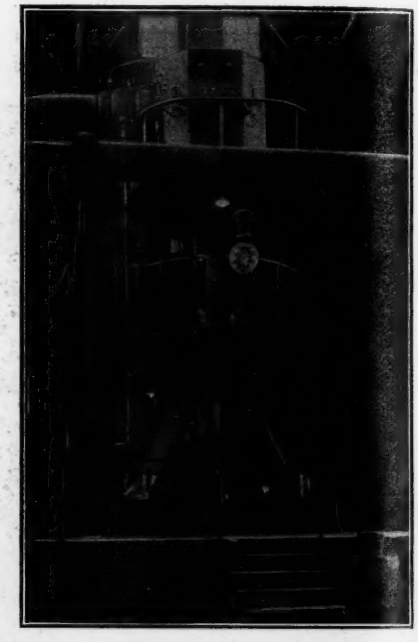
Cutting Out Cement Rock at Quarry, Edison Portland Cement Company, New Village, N. J.

Under each roaster are fifteen sets of friction wheels, and the roasters are revolved on these wheels through a motor and gearing. The main gear is situated a little below the centre of the roasters, and the shell is turned by a twenty-five-horse-power motor. The material comes into the back of the roasters, about ninety per cent of it passing through a 200-mesh screen. The clinking zone is about sixty feet long, commencing ten feet from delivery, and thirty feet from the end of the roasters. The heat is supplied to the matter in the roasters in a novel way. Pulverized gas coal is delivered from an elevated bin and injected into the roaster by compressed air at a pressure of 100 pounds. The amount of coal fed to the roasters is regulated by friction-driven screws. As the chalk passes through the roasters it comes in contact with this burning coal. The resulting clinker falls by gravity into a revolving cylindrical cooler, and from this into bucket conveyors Nos. 125 and 126. The latter conveyor delivers into the first clinker-crushing rolls. Then the material passes to the second clinker-crushing rolls, and by gravity to elevator No. 127. This elevates it to scraper conveyor No. 128, from which it is distributed to the clinker stockhouse, which has a capacity of 2,500 tons. These are thirty-six-inch rolls, and are duplicates of those described in the crushing plant.



The Automatic Skip Dump, Edison Portland Cement Company, New Village, N. J. This Dump Is Worked by Electric Motor, as Is Also the Hoisting Apparatus for Elevating the Cars. The Apparatus Is Controlled by Operator on Platform to Right of Dump.

The crushed clinker is taken from this stockhouse by chutes to belt conveyor No. 129. Here the proper amount of sulphate of lime or gypsum is added, and the material is then taken by belt conveyor No. 130 to elevator No. 131. The same process as that in the chalk plant is repeated here, the fine material settling into the dust chamber and being transferred by scraper conveyors Nos. 139 and 140, from which it is taken by belt conveyors Nos. 143 and 144 to the cement stockhouse, which has a capacity of 100,000 barrels.



One of the Engines, Edison Portland Cement Company, New Village, N. J.

The coarse material which is rejected by the blowers in blower house No. 2 is carried back by belt conveyor No. 138 to belt conveyor No. 132, which delivers it to the feed roll hopper over the grinding rolls. It is then taken through the same process until it has been reduced to a state fine enough to be deposited by settling in the settling chambers.

The cement, which is ground so that eighty-five per cent passes through a 200-

mesh screen, is dumped into two piles in the cement stockhouse, and beneath these piles there is a traveling screw conveyor, No. 145. This conveyor delivers from either pile to screw conveyor No. 146, and from this conveyor the material is taken by belt conveyor No. 147 to the bins of the packing house. The packing house contains four bagging and two barreling machines.

A very interesting part of the process is the preparation of the coal for use in the roasters. It is brought in on hopper cars and dumped over a grizzly. The fine coal falls through this grizzly into a large hopper, from which it is fed by feed rolls to conveyor No. 175 to the coal stockhouse. This coal stockhouse has a capacity of 400 tons. From the coal stockhouse it passes by means of belt conveyors Nos. 176 and 177 to the hopper over the coal dryer. The coal dryer consists of cast-iron sectional box, six feet by seven feet twelve feet. The coal passes down on either side by means of baffle plates to a storage hopper below. The heated air is forced into the dryer and passes through the coal, absorbing all its moisture. A 110-inch blower forces the air through steam coils to the dryer at the rate of 30,000 cubic feet per minute. Conveyor belt No. 177½ receives the coal from the storage hopper after it has passed through the drying plates, and from here it is taken to a Smidth ball mill by belt conveyor No. 178. In the ball mill it is continuously pounded in a revolving shell which is partially filled with steel balls. From this mill it is conveyed by screw conveyor No. 178½ to the tube mill.

This tube mill is a long cylindrical shell, partially filled with quartz pebbles, by means of which the coal is further pulverized. The ball and tube mills are driven from a line shaft, and the engine driving this shaft is a 250-horse-power horizontal tandem-compound. The exhaust from this engine is used in heating the coils through which the air is forced to absorb the moisture from the coal. The pulverized coal, after leaving the tube mill, is forced by a screw conveyor to transfer tower No. 5. This transfers it on another screw conveyor, which delivers it into the fine coal stock-bin. The capacity of this bin is 100 tons, and from this bin the coal is carried direct to the bins at the roasters by screw conveyor No. 137.

The steam supply for the whole plant is furnished by three vertical Climax boilers of 2,000-horse-power capacity. The compressed air is furnished by two McKernan Drill Company's air compressors. These supply the compressed air for injecting the pulverized fuel into the roasters, and also for the air used in regulating the pressure on the twenty-eight-inch rolls in the chalk-grinding house and in the clinker-grinding house.

THE ROASTERS, EDISON PORTLAND CEMENT COMPANY, NEW VILLAGE, N. J. THESE KILNS ARE EACH 160 FEET LONG, AND ARE OPERATED CONTINUOUSLY, BEING REVOLVED BY TWENTY-FIVE HORSE-POWER ELECTRIC MOTORS.

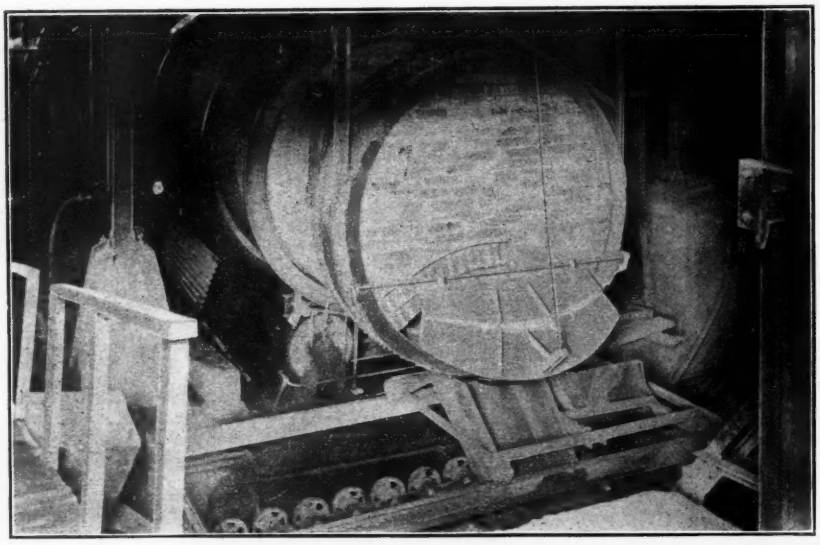
A thoroughly equipped machine shop is an important adjunct to the plant. This shop is 360 feet long and sixty feet wide. The castings for different machinery are received here and finished up. There is also a department for structural ironwork in this machine shop, a pattern shop, electrical repair room, a carpenter shop, storage for patterns, and a storage room for repair parts.

The laboratory is situated in the office building. This includes the physical testing room and the analytical department.

A complete system of signals has been

established from the superintendent's headquarters at the office to every foreman of a department throughout the works. There is also an annunciator system, by which any foreman can call a messenger for the delivery of reports to the office.

An elaborate oiling system has been established, whereby all of the oil is fed directly to the parts requiring lubrication. The oil which passes through the different parts of the machinery is collected by gravity in tanks, from which it is pumped to a filtering apparatus in the oilhouse. This oilhouse is located practically in the centre of the works. After the oil has been filtered it is pumped from the oilhouse to individual tanks in the top of each of the buildings, from which it drops by gravity to the necessary ports. The



THE LEAVING END OF THE ROASTERS, WHERE THE CLINKER FALLS INTO AN ELECTRICALLY DRIVEN BUCKET CONVEYOR TO BE CARRIED TO THE CLINKER CRUSHING ROLLS.

supply of oil to the working parts is regulated by needle valves, and is also in very nearly every case sight-feed. A 500-volt generator is used for supplying current for a water power station. The company has established a reservoir holding 5,000,000 gallons of water, and this is served by a Worthington triplex pump.

The buildings are constructed throughout of structural steel and concrete. The different rolls are supported upon massive stone pillars, and the crushing house is a substantial concrete and steel structure. There are about 100 electric motors in use for conveyors, elevators and blowers, supplied by ten generators. All of the electric wiring is weatherproof and fireproof, and the construction is such as to render the possibility of damage by fire slight. In fact, the precautions are so numerous and well designed that the chance of accident of any nature is almost entirely eliminated.

OVERHEAD HIGH-TENSION DISTRIBUTING SYSTEMS IN SUBURBAN DISTRICTS.[1]

BY GEORGE H. LUKES.

An overhead distributing system must be constructed so that the service will be reliable and not subject to frequent interruptions. The voltage regulation must be as good as possible and danger to life from fire reduced to a minimum. This can be accomplished without adopting an extremely expensive method of construction. The great proportion of accidents and interruptions are caused by defects which are very easily guarded against, provided they are looked for. It is not the intention here to lay down rules for the construction of pole lines, but to draw attention to certain points which experience has shown to be often neglected.

Main Lines and Branch Circuits—Main lines leading from stations should be on not less than forty-foot, and preferably on forty-five-foot poles. This gives plenty of room for additional circuits and makes it easier to cross above telephone and telegraph lines. The branch circuits can be on shorter poles, but it is not advisable to use poles shorter than thirty feet. Where branch lines are taken off, the poles should be doubled-armed and buck-armed. Transformers, fuses, lightning arresters and other devices should not be installed on main lines where it can be avoided.

Poles—In the Middle West, the poles available at present are Michigan white cedar and Idaho cedar. Michigan poles are better proportioned than western poles and are longer lived. Michigan poles should have a top diameter of not less than seven inches. If western poles are used, it is well to note that eight or nine-inch tops should be specified in order to obtain proper butt diameter. Michigan poles are sorted and sold under the specifications of the Northwestern Cedarman's Association and it is therefore cheaper to buy under the above specifications and sort out to suit. Poles should be shaved, roofed and given one coat of paint in the yard. Poles are painted in order to improve their appearance, but the question of whether or not it adds to the life of the pole is an open one. In setting, particular care must be taken to select the best poles for the corners, turns, and ends of the line. If the line is on a highway that curves, set as many poles in a straight line as possible and make the turns on one or two poles, which can then be properly guyed. A line that changes its direction at every pole can never be held in position. Poles should be doubled-armed at corners, curves and ends.

Guying—This is one of the most important features in pole-line construction and is often neglected. Corners, junctions and ends should be carefully guyed. Wherever the line changes in direction, even if the change is very slight, a guy should be placed. Patent guys and land-anchors should be used with great caution and only on light work. The best guy is the old-fashioned one consisting of a guy-stub, set at some distance from the pole with a galvanized iron anchor rod-bolted to a slug buried in the ground. Strain insulators should be inserted in the guy-wire and care should be taken to make sure that the anchor-rod and guy-wire attached to it are grounded electrically.

Cross-Arms—The best cross-arms at present are made of southern yellow pine. They should be straight-grained, well seasoned, free from knots, and purchased unpainted. They are the first part of the line to give out. The action of the sun's rays causes the arms to crack on top and they soon rot around the pin-holes. The usual method of treating is to paint them with white lead and oil, but in the West cross-arms boiled in carbolineum have been used to some extent. The matter of the proper dimensions and pin-spacing for cross-arms has not received the attention it should, and it is high time that an attempt be made to standardize four, six and eight-pin arms for use on circuits up to 5,000 volts. The proper six-pin arm for such use should

[1] Abstract of a paper presented at the 182d meeting of the American Institute of Electrical Engineers, New York. December 18, 1903.

have approximately the following dimensions: section, three and one-quarter inches by four and one-quarter inches; length, eight feet; spacing, between pins about sixteen inches, between pole-pin about twenty-two inches. Cross-arms for junction holes should be of special size with greater distance between pins.

Insulators—The ordinary deep-grooved, double-petticoated insulator has proved satisfactory on 2,000-volt incandescent and 4,000-volt arc circuits. It is perhaps advisable to use triple-petticoat insulators on 4,000-volt polyphase work.

Fuse blocks and lightning arresters are sources of trouble on pole lines. In some instances systems have been operated entirely without fuse blocks on the outside lines excepting, of course, the transformer blocks. The best plan is to install them on branch lines where there is a chance for trouble. Lightning arresters should be installed to protect groups of transformers and branch lines. They should be frequently inspected and the ground wires tested.

Transformers should be hung on double-arms below the lowest arm. If they are of large size the arms should be extra heavy and bolted securely to the pole. Methods of bringing the primary wires down from the circuit to the transformer are various and all are open to objections.

It is usually impossible to keep a regular arrangement of circuits upon cross-arms for the reason that as the business grows, circuits of all kinds are added. It is very desirable, however, that circuits be kept in the same relative position throughout their length in order to facilitate tracing. Houses should be, as far as possible, grouped upon three-wire secondaries which should be carried alone on the lower arm. The installation of 200-400 volt, three-wire secondaries would facilitate this work wonderfully in scattered districts. The neutrals of three-wire secondaries should be grounded on the first pole away from the transformer.

All series alternating arc lamps should be provided with absolute cutouts and high-voltage insulators in the lowering cable. Windlasses for raising and lowering lamps should be permanently grounded and an arc lamp when suspended from span-wires should be connected so that, should it fall, the lamp will not fall toward the windlass but away from it.

The importance of frequent inspections of pole lines can not be overestimated. Old pole lines can be made very reliable, provided they are well guyed and weak points kept in repair. For inspection work, linemen of considerable experience are needed, because only long years spent in repair work gives the ability to predict where trouble is likely to occur.

Accidents caused by overhead wires are remarkably infrequent, considering the number of miles of pole lines operated. They occur most often to electric linemen, less often to telephone linemen and very rarely to citizens. Accidents to linemen can largely be prevented by employing on live work only steady and tried men and using the inexperienced men and floating linemen on new construction work. Accidents to telephone linemen are mostly the result of want of care on the part of the men themselves. Accidents to citizens can be reduced to a minimum by care in constructing and maintaining lines.

The danger from fire is in the possibility of high-voltage current reaching buildings; first, through defective transformers, and secondly, through crosses between primaries and telephone wires. The first can be eliminated by grounding the secondary; the second can be made remote by proper cooperation between electric light and telephone companies in the erection of junction poles and substantial construction. The danger from fire is somewhat overestimated and it is to be sincerely hoped that any restrictive regulations will not only be carefully considered before final action is taken, but worked out in actual practice to determine whether or not their enforcement would introduce risks which would more than offset any advantage gained.

Mr. Westinghouse on "The Third-Rail Danger."

Replying to a request for an opinion on the danger of a third-rail system, in city tunnels, Mr. George Westinghouse has written the following letter to the New York *Evening Post:*

"Replying to your letter of December 12 concerning the third-rail question, I think the following points will be generally admitted:

"(1) That the operation of the elevated trains by electricity has been an undoubted success, and an enormous advantage to the traveling public, notwithstanding the fact that the continuous third rail has been employed to supply the current.

"(2) That the deaths and injuries to passengers and employés, considering the number of people involved, compare most favorably with any other railway operation in the world.

"(3) That if a third rail charged with an immense power of electricity and located upon the surface near the other rails is to be used for the supply of electricity to the trains, then there will always be a source of danger to those who have occasion to come near such third rail, and in addition there will always be a great source of danger due to the fact that a car may be derailed, or that some iron material may become detached and make a short-circuit between such third rail and the train.

"(4) That this third-rail danger may be lessened by the subdivision of the third rail into sections with provision for the automatic supply of the required amount of current to each section only as required, but that such arrangement will only minimize the third-rail danger.

"(5) That such third-rail danger may be entirely obviated by resorting to the use of overhead conductors, for which the elevated structure is peculiarly suited.

"(6) That there never was a good reason why the overhead wire should not have been used.

"In support of these last two propositions it may be stated that the third-rail is impossible for use on main railways at important junctions and terminals; that the Pennsylvania Railroad does not propose to use the third rail in its underground work between New Jersey and Long Island; that the overhead wire was used at the Zossen experiments in Germany, when a speed of 120 miles per hour was obtained; and finally, that the New York Railroad Commissioners have recently declared that they would not permit the use of a third rail on interurban lines crossed many times by highways.

"It may seem to be heresy to advocate the use of the overhead wire, but I venture to predict that there will be a complete revulsion of feeling on this point. When I speak of an overhead wire, I do not mean the slight construction which has prevailed, and the breaking down of which has occasioned trouble, but a substantial engineering arrangement so erected that it would, in fact, not be an offense to the eye. It is obvious that the use of an overhead trolley, with the removal of the third rail, would make impossible the present risks of short-circuits between the car or parts of the car and the third rail; but it would leave other questions yet to be settled; namely, first, the proper application of the electric apparatus to those cars, so that in no event could the passengers be frightened by a short-circuit visible to them, and this means that all of the wiring and electrical apparatus would have to be located beneath the bottom of a fireproof car and with no wires carrying large currents above the floors or near the ends of the cars which might be damaged by accident.

"I am satisfied, from my conferences with railway officials, that they are moving in the right direction and giving this subject the attention it deserves; but it must be borne in mind that it has required experience to demonstrate what is necessary for safety.

"Very truly yours,

"GEORGE WESTINGHOUSE.

"NEW YORK, December 14, 1903."

STANDARDIZATION OF APPARATUS.[1]

BY J. C. KELSEY.

Before railways had grown to such extent that they had reached the terminals of other railways, each system made use of its own particular standards. For instance, one system had a broad-gauged track and axle, another a narrow-gauge and still another an intermediate-gauge. When conditions due to modern business methods demanded a rapid and uninterrupted interchange of traffic between all parts of our country, the terminals of a certain system were extended to meet the terminals of another system, and a common width of truck and axle became necessary. This resulted in what is called the standard gauge, and now all rolling stock is built to operate on this gauge, making possible the fast freight and comfortable through passenger service of the present day.

When telegraph companies were operated by different managements in the different districts of the country, each management had its own particular style of apparatus, and manner of operating it. Some systems used fast machine operating, and others, the slower manual method. As a consequence the systems could not be operated as a unit, and much time and expense were necessitated in getting long-distance service, because each system had to operate and record the message in its business way. Like the railroads, the telegraph met a demand for through service between cities and districts, and this necessitated a similarity in the style and usage of the apparatus in both sending and receiving systems. This similarity or standardization has given to the public a more rapid and reliable telegraph service.

Telephone systems, trying to compete in the transportation class, are naturally sure to encounter the same, and they are encountering the same, demands that are made upon the telegraph and railway. No longer can the telephone subscriber be confined to a limited district. He desires to talk to his neighbor, and that neighbor may be one mile or forty miles distant, or he may be one thousand miles away, in another management's district. Whatever the case, the subscriber wants to hear his neighbor's voice or his customer's voice or his client's voice, just as plainly as in ordinary conversation, and he does not care to have his message repeated by a careless operator, any more than the passenger bound for New York would care to change cars at Cleveland and Buffalo. Therefore, successful competition in telephone transportation demands standard tracks, that through connection may be made, and efficient apparatus, that will operate as a unit with this track, at both sending and receiving ends.

Experience has already decided the gauge of the telephone transportation track—copper wires. Whatever the locality of this track or line, its characteristics are in general the same. It is a well-known fact that this line must be transposed and well balanced to be quiet under all disturbing conditions. If of a considerable length, it becomes very sensitive to unbalances, and upon connection with a local exchange subscriber will quickly prove the unbalanced condition of the local switching apparatus, which would never be disclosed by a short toll line, or a purely local line. But if this toll line extends into territory where trolley wires, high-tension and electric light wires abound, it develops still more decided characteristics. It becomes supersensitive, and may be said to be looking for trouble. The unbalance that the long unexposed toll line would not detect will now be disclosed by a roar so great as to forbid conversation.

As the interurban lines, with their accompanying high-tension wires, invade the country, each and every exchange operator will inevitably experience this changed condition of his toll line. His local lines and switching apparatus, which once gave him good toll service, will be rendered comparatively useless, as the oversensitive toll line will not permit of the least unbalance. If this oversensitive line connects with an exchange using series drops in circuit, the connection will be too noisy for use. If it connects with a common return system, great noise will result. If it connects with a metallic exchange, with lines having bad joints and careless structure, the connection will also be too noisy for use. If it connects with a well-balanced metallic system, using cheap or poorly designed transmitters, poor transmission will result. If it connects with a common battery system, using twenty-volt battery pressure, the connection is noisy, and the signals are rendered inoperative. The same condition will apply to the forty-volt common battery system. Therefore, in view of the great number of independent exchanges, it is not likely that every exchange owner will consent to the making of radical changes. He will consent to any moderate change that will ameliorate conditions, and luckily, the repeating coil, if properly designed, will accomplish the result. This sadly neglected device must receive first aid and attention in the campaign of general standardization.

What does general standardization mean? Does it mean that each and every system shall be manufactured by the same company? No! Every company can manufacture standard drops, relays, ringers, generators and other devices. It means that a standardized system is one, if applied to local battery, that will operate in direct conductive relation with the standard toll line track, without the least noise due to unbalance, thereby giving absolute sway to the voice tones. To attain this efficiency, a system would have to have balanced and well-insulated metallic lines, 1,600-ohm bridging bells, 1,000-ohm clearing-out drops, and open-circuit generators. The absence of repeating coils and series apparatus would be quite conspicuous. However, if it is necessary to have a grounded party enter the standard exchange, a suitable repeating coil should be placed in circuit between the terminal arrestor and the line jack. What would be a suitable repeating coil? Can a single standard repeating coil be made? No! there is more difference in repeating coils than in any other telephone apparatus. Like lighting and power transformers repeating coils should be built for load and frequency, and carefully constructed. But as they are not a part of a standard system, no time will be spent on their characteristics by this paper.

What is a standard common battery system? It is one that will give a quiet line connection, and efficient transmission between the long-distance points. But strange to say, at this very moment, there is an idea gaining ground that common battery transmission has not come up to standard. As a result, one will find many companies maintaining local battery stations for long-distance service. It is an unfortunate condition, and I am compelled to admit the justification of the idea. The blame does not rest upon the system, because all transmitters have a central source of energy, for no reason can exist why a common battery transmitter can not be made just as good as a local battery transmitter. Nor is it a question of battery voltage, for on local service, one can not tell the difference between ten, twenty or forty volts, transmission being the best in all cases. But why is there difficulty upon long-distance connections? It is because of the generally mistaken idea among telephone engineers of the value of the electromotive force of

[1] Abstract of paper read before the Interstate Independent Telephone Association, Chicago, Ill., December 9, 1908.

the alternating currents of common battery voice currents, which leads to the improper design of the repeating coil between the common battery subscriber and the long-distance line.

In explanation, a comparison will be made. It is conceded that a local battery induction coil must have comparatively few turns in the primary, and a great number of turns in the secondary, in order to transmit a small amount of current at a high pressure, and avoid the losses which would result from heavier current and low electromotive force. We will all admit that if this induction coil had equal turns on secondary and primary, we could not look for very good results on long-distance service. This is precisely the difficulty the common battery systems are contending with. They either use repeating coils of equal windings, of no potential raising power, or condensers with the effect exactly the same, and then expect a low electromotive force to transmit the voice currents to great distances. For the electromotive force of common battery voice currents is low, very low, and it is safe to say that it does not exceed the primary voltage of local battery instruments. If it is necessary in local battery practice to raise this low primary voltage to a high secondary voltage, running up into hundreds, why is it not necessary for the common battery systems to adopt the same practice? Common battery systems can be standardized, and the subscribers deserve it, for they do the bulk of the long-distance business.

A New Submarine Cable Plant.

The John A. Roebling's Sons Company has just completed a new building which will enable it to largely increase its product of insulated wires and cables of all kinds, and will provide room for introducing on an adequate scale the manufacture of submarine cables. It has made submarine cables for many years, but this part of its business seems to demand greater facilities, and to provide for this, one of the largest and most complete plants in this country will be installed.

The new buildings are located so that shipments may be made either by water or rail, and the company will soon be in a position to solicit the largest contracts in this line.

Both rubber and gutta-percha core is used, and its present large rubber plant will take care of those orders calling for insulated cables. Formerly it has imported gutta-percha core, but it is its intention, in the new plant, to provide a complete factory for manufacturing this core under the direction of a most competent and experienced manager, who has had a long and successful experience abroad in this kind of work.

It is the company's intention to so equip its new factory that submarine cables of any kind of core, with any description of armor, may not only be made, but it will also provide the necessary apparatus and equipment to lay any of the cables it manufactures.

The Roebling company will be in a unique position among American manufacturers, not only in the variety of insulations it can furnish, but also from the fact that it will be prepared to take contracts to turn over to the purchaser the submarine cable, laid and ready for use. It will also have the advantage of manufacturing all the constituent parts of a cable, *viz.*, copper wire, insulated core and armor wire. This should not only reduce the cost, but it should ensure to the purchaser the best materials, all manufactured under one supervision, and for which one company will be responsible.

The Roebling company has a reputation for taking large contracts, and its responsibility is also well and favorably known. It is expected that the new factory will soon be engaged on large government contracts for this class of materials.

The Opening of the New Bridge between the Boroughs of Manhattan and Brooklyn, New York City.

On Saturday, December 19, the formal exercises connected with the opening of the new Williamsburg bridge, joining the boroughs of Brooklyn and Manhattan, New York city, were held. The officials of both boroughs marched across with their escorts from the two ends of the bridge, meeting in the centre, where the formal exercises of opening were commenced. Mayor Low and President Swanstrom, of the Borough of Brooklyn, then led the way to the Brooklyn side, where, in the eastern district, a pageant was reviewed and congratulatory exercises held at the plaza, at the Brooklyn end of the bridge. The different organizations representing the business interests of Brooklyn, and several military organizations, were in line.

Among the more prominent officials were Mayor Low, Borough President Cantor, of Manhattan; Alderman James H. McInnes, vice-president of the board of aldermen; James B. Reynolds, Mayor Low's secretary; Comptroller Grout; Captain Perry, of the Brooklyn Navy Yard; Health Commissioner Lederle; Lieutenant-Commander Barry, of the United States Navy; Chief Judge Alton B. Parker, of the Court of Appeals; former Governor Levi P. Morton; Police Commissioner Greene; J. Edward Swanstrom, borough president of Brooklyn; Joseph Cassidy, president of the Borough of Queens; Bridge Commissioner Gustav Lindenthal; Lefferts L. Buck, chief engineer of the department of bridges; John L. Shea, former bridge commissioner; David A. Boody, Charles A. Schieren, Frederick W. Wurster, Daniel D. Whitney, Albert C. Chapin, former mayors of Brooklyn. There was also a notable attendance of engineers and city officials.

Electric Lighting of the Welland Canal.

It is reported that the work of installing the arc lighting equipment for the Welland canal is now under way. It is proposed to place a 2,000-candle-power alternating-current enclosed arc lamp every 500 feet along the canal, with six lamps at each lock. The contract for the erection of the necessary poles has been given to Mr. Joseph Battle, of Thorold, Canada, and tenders will shortly be called for the electrical supplies, including arc lamps, transformers, transmission line material, and for the construction of the line and terminal station. The terminal station is to be located at Thorold, Canada. It is proposed to install three-phase circuits for distributing the current to the motors for operating the lock gates, weirs, bridges and yard shops. The Lincoln Electric Light and Power Company, St. Catharines, Canada, has been given a ten years' contract to furnish the electrical energy. The plans for the complete equipment of lighting the canal were prepared by Roderick J. Parke, of Toronto, Canada.

American Electrochemical Society.

The executive committee of the American Electrochemical Society is requesting papers from members, to be presented at a meeting of the New York section, which will be held at an early date—probably during the month of January. Short, informal talks on any practical subject are especially solicited. Mr. Alois von Isakovics is the secretary-treasurer, 451 East 121st street, New York city.

The American Institute of Electrical Engineers.

Central Stations the Subject for the 182d Meeting, Held in New York City.

THE one hundred and eighty-second meeting of the American Institute of Electrical Engineers was held in the chapter room of Carnegie Hall, 154 West Fifty-seventh street, New York city, December 18. The subject of the meeting was central stations, and several papers of more than ordinary interest were contributed. Owing to the temporary absence of Mr. B. J. Arnold, the president of the Institute, Mr. Calvin W. Rice presided and opened the meeting.

The first paper called for was on "Overhead High-Tension Distributing Systems in Suburban Districts." In the absence of the author, Mr. George H. Lukes, this paper was read by Mr. H. B. Gear, of the Chicago Edison Company.

Following the reading of this paper, the secretary announced that at the business meeting held during the afternoon, fifty-one associates had been elected, thirty students enrolled, and three members transferred from associate to full membership. These were Mr. H. L. Reber, of St. Louis, Mo.; Mr. F. O. Blackwell, of New York city, and Mr. E. E. Stark, of San Francisco, Cal. It was also announced that the next meeting of the association would be held at the Chemists' Club, 108 West Fifty-fifth street, New York city, on January 29, 1904.

After these announcements, Mr. Rice said that the paper by Mr. Lukes was valuable, in that it pointed out a number of important propositions which every central station manager had at some time to contend with. The question of the relation of companies to the municipality, the citizen and the fire underwriters was important, and he hoped that, in the discussion, these matters would be very completely taken up.

The next paper was by Mr. E. J. Bechtel, on "Automatic Apparatus for Regulating Generator and Feeder Potentials." In the absence of Mr. Bechtel, this paper was also read by Mr. Gear. Mr. Bechtel pointed out the fact that the efficiency of the conversion of electricity into light depends greatly upon the maintenance of a constant potential at the lamp terminals. For instance, a system having a potential regulation of two per cent can profitably use incandescent lamps which consume 3.1 watts per mean horizontal candle-power, based on the oval filament type of present quality, while a poorer regulation factor would require the use of lamps consuming from 3.5 to 4 watts per candle-power, representing a sacrifice of from 12.5 to 30 per cent in conversion efficiency. He described the type of automatic generator potential regulator which had been used in the Toledo Railway and Lighting Company's plant, on generators up to 250 kilowatts capacity, and which had given good service in alternating work. However, difficulties were experienced in the use of even the best designs of automatic regulators.

In commenting on this paper, Mr. Rice said that it offered an opportunity for the discussion of an important point, and he thought valuable information could be derived on this subject. The essential feature of operating central stations, particularly those which supplied current for incandescent lamps, was the definite knowledge of the point where it was safe to use a certain type of lamp to suit the regulation possible. The point of automatic regulation of the generator *versus* feeder regulation was one that should be given a great deal of consideration. In original installations, the automatic regulation of the generator was almost entirely the case. With the large systems of today, however, feeder regulation is very necessary and automatic regulation is essential.

Mr. W. C. L. Eglin read his paper on "Safeguards and Regulations in Operation of Overhead Distributing Systems." Mr. Eglin took up, in turn, the evolution of the city, with its inevitable ramifications to suburban properties, necessitating outlying service and the tying together of existing properties under one operating company. It was often the case that these existing properties showed wide variation in the type of apparatus installed, and the engineer had a difficult problem to solve in making a merged system work well as a unit. He took up in detail the specifications for material to be used, giving dimensions and treatment for poles, cross-arms, braces, pins, insulators, lightning arresters, series arc loop cutouts, interference with other wires falling or coming in contact with power circuits, effects of lightning storms, transformers, and emphasized the importance of thorough inspection.

At this point the question was raised as to whether discussion should follow on the three papers already presented, or whether a fourth paper by Mr. J. R. Bibbins, on "Gas Power for Central Stations," should be read and the discussion then taken up. On vote it was unanimously decided to have Mr. Bibbins read his paper.

Mr. Bibbins, in his paper, offered testimony on four contentions: one, that present gas power machinery is suitable for central station service; second, that a well-equipped gas power electric plant can operate with far better economy than a steam plant under similar conditions; third, that its operation is much simpler and requires lower running expenses for the same results; fourth, that gasworks laboring under low load or output factor can profitably install a gas power electric generating station and become its own largest customer, selling both gas and electricity at competitive rates.

The basis of the paper consisted of data collected from various electric light and power plants in the United States, using gas engines as their principal motive power. A number of these plants were operated in connection with illuminating gasworks, and it had been possible to observe the somewhat unique position of the gas engine station as a direct, though affiliated, competitor of the gasworks. Speaking of the possibility of continuity of service with a gas engine plant, he quoted a sixty-five-horse-power two-cylinder vertical engine as having, out of a total elapsed time of 8,472 hours, made a run of 8,230 hours. Of this 242 hours lost time, but three per cent was chargeable to the engine. Mr. Bibbins thought that the skill required for operating a gas plant was no greater than that for a steam plant; and in several instances where the steam plant had been replaced, the old employés had been retained. In newly established plants, steam engineers had invariably taken charge after a short preliminary instruction from the builder's erecting engineer. He thought that, in the economy of fuel, the gas engine had no rival. The present limit of steam engine practice was ten pounds of water per indicated horse-power-hour or eleven pounds per brake horse-power-hour. With an evaporation of ten pounds of water per pound of good coal (14,000 B. T. U. per pound), a performance of 1.1 pounds of coal or 15,400 B. T. U. per brake horse-power-hour is realized. The gas engine at present delivers at full load a brake

horse-power-hour upon 10.5 to 11 cubic feet of gas (of 900 to 1,000 B. T. U. per cubic foot calorific value), which is equivalent to from 10,000 to 11,000 B. T. U. per brake horse-power-hour.

In summing up the advantages of the gas engine for central station, he thought that it showed a possibility of minimized fuel and heat consumption. The light-load efficiency was higher than for steam engines of corresponding size, and the cost of maintenance and operation was low. The equipment was simplified, a small number of auxiliaries was required; there was an absence of stand-by losses; quick starts could be made, and the waste heat in the jacket water was suitable for building heating. He took up the values of the fuel gases and the forms of gas which gave best service in internal combustion engines.

Referring to station economy, Mr. Bibbins's observation showed an average for several months' operation for day-in-and-day-out running in most cases in favor of the gas plant.

Mr. Gear opened the discussion by reading a paper which he had contributed to the subject. In this paper he emphasized the importance of thorough inspections and thorough drilling of employés in the dangers of handling high-tension circuits, and advocated the use of rubber gloves for linemen, and the use of weatherproof wire in construction work.

Mr. George T. Hanchett took the floor and stated that one of the most prolific causes of trouble to circuits of both high and low powers was in the grounding of wires by trees. Other than the absolute removal of the tree, he had found no satisfactory means of preventing this trouble, and thought it a good opportunity for any one who had solved this problem to give the engineers the benefit of his knowledge on this point.

Mr. Ralph D. Mershon made a vigorous protest against the use of so-called weatherproof wires for primary circuits. He said he would like to know why it was ever used. A weatherproof wire promoted a false confidence. He had always tried to use bare wires for primary circuits. With a new weatherproof wire there was some protection in dry weather. Later on, when the wire commenced to wear, it was more than unsightly and it was an absolute menace to linemen in the case of having to work on it during a storm.

In discussing Mr. Bibbins's paper, Mr. Mershon thought that it was not a fair comparison between the gas and steam engine plants. Figures should be given for a purely power station for both steam and gas economy. He thought that if every point were given its correct specifications, that the figures would not show so favorably for the gas engine plant. He did not wish to go on record as being an opponent of the gas engine. He thoroughly believed that the time was coming when the gas engine and gas producer would take the place of the steam engine and steam boiler, unless we should produce a satisfactory gas turbine. He said that he had observed a number of plants operating in foreign countries, and thought that the gas engine plants which work on the suction principle were particularly successful. In this system, the gas engine draws its fuel mixture only as it is needed. This method was made necessary because of the police regulations prohibiting the storing up of any great quantity of combustible gas. His observation had shown that steam was, in every case, favorable from an economical and operating point of view, and he thought that not only was this the case, but that the maintenance cost was higher with the gas engine, and that the practice in Germany had shown this to be so. Another point which he considered was against the rapid adoption of gas engines, was the high price demanded for units by the American manufacturer.

Mr. Bibbins replied, that the paper did not bring into comparison large stations—it simply covered the experience of the stations under consideration. These were not large, and the estimate was simply made to bring out the increased value of producing electricity in combination with the production of gas. The comparative cost of gas and steam engines depended on several conditions. When the holder capacity was taken into consideration, the cost would probably be in the ratio of $125 per unit of gas engine as against $100 per unit of steam engine. On the question of maintenance, his observation had justified the conclusions reached in his paper.

Mr. Paul M. Lincoln took the floor and made several excellent suggestions with regard to the use of insulators. He stated that every engineer should make it a point to depend entirely upon an insulator for insulation, and to make the pin no part of the insulation of a high-tension system. If anything at all were to be done with the pin, it should be made a good conductor, in order that if there were a leakage of current the resistance would not be such as to create a burning which would destroy the pin.

In reply to a question on the parallel operation of gas engines and on fluctuating loads, Mr. Bibbins stated that his observation has shown that the spring coupling almost universally used had been satisfactory in taking care of this difficulty.

Mr. Rice called upon Mr. M. P. Rider to give his testimony on the question of the insulation of high-tension wires and the use of weatherproof wire. Mr. Rider thought that weatherproof wire was a very good protection in dry weather, on potentials up to 2,500 volts. There were many times when crosses were avoided with the use of this wire. He admitted that when weatherproof wire became worn and the binding frayed out and made streamers all along the line, it was unsightly, and that in wet weather the weatherproof insulation was not an insulation. On the subject of lightning arresters, he has never as yet found anything to be an absolute protection against lightning. He did not think it paid to use a great number of protectors. The greatest part of the trouble from lightning discharges occurred at either end of the circuit, although sometimes trouble was experienced out on the line. He thought that a couple of good lightning arresters at each end of the line was sufficient protection against lightning storms. A point that he would like to have information on was the reason why lightning storms invariably caused the blowing of the primary fuses, without injuring the transformer in any way.

Mr. Fremont Wilson caused considerable amusement by accusing Mr. Rider of having no lightning arresters on his (Mr. Wilson's) end of the line, and said that he now knew why trouble existed. He stated that he thought the use of weatherproof wire a farce, and that not only was the weatherproof wire unsightly, but it was a menace, in that it produced a false confidence and allowed people who would otherwise steer clear of the wire to come into contact with it. He questioned the danger of running high-tension wires through trees and the possibility of shock during a period when a tree was wet. He said that the use of rubber gloves should be abandoned, as it was not possible to detect a fault in the glove until a potential was being handled which would probably prove fatal.

Mr. Philip Torchio, Mr. Wells and Mr. Bibbins then carried on the discussion on the gas engine, and Mr. H. A. Wagner told of a station which had had anything but a satisfactory experience in the use of gas engines, abandoning them for a steam plant. These engines, however, had not

been of the latest type, but this company's experience seemed to show that the gas company could not produce current profitably.

Mr. Calvert Townley quoted an interesting experiment which was made on a railroad system in western Pennsylvania, with regard to the operation of lightning arresters. A lightning arrester had been placed on every pole, and during a storm the working of these arresters was observed. Tissue paper was placed in the regular way, and after the passage of the storm the protectors were examined. It was found that, notwithstanding there was a lightning arrester on every pole, there were but four to the mile which had been affected. It seemed to him that this was adequate protection, and that the lightning never picked out more than this number of paths to the ground. In early practice, he said, it was the custom to put the lightning protection in the station. He thought it was good to have some out on the line, as lightning did not always hunt up the station to find a lightning arrester, but frequently took an opportunity to discharge through a transformer.

Professor George F. Sever stated that the department of electricity, water and gas for Greater New York was having some difficulty in devising the proper means for getting the high-tension circuits underground. Ninety-eight per cent of the telephone wires were underground, but he could not say what percentage of lightning and power wires had been taken from the aerial lines. It was a vital question, however, for the engineers to decide, and there should be no evading of the matter. It was a business proposition which should be approached in a business way, and it should be a point of honor with every engineer to either remove the high-tension circuit from proximity with the telephone and signal line, or remove the signal line from proximity with the high-tension circuit. There should be no possibility of these circuits falling one upon the other.

Mr. Rider, in reply to a further question, stated that there were a great many of the underwriters' rules which were very impracticable. The ordinary high-tension conductor used in this territory was of such a nature that it would stand up against all sorts of weather conditions, and that the solution of the problem consisted of putting the low-tension wires below the high-tension wires, as these were the most likely to break.

Mr. Eglin, in reply to a question with regard to the insulation of wire running through trees, said that his company had made a number of experiments to avoid this difficulty, and had invariably failed. The last experiment which they had made, and one in which they had placed considerable hope, was with a specially prepared wire which had a heavy rubber insulation, and about this rubber insulation there was wound an iron armor wire. It was thought that the armor wire would prevent the limbs of the tree chafing the rubber and breaking down the insulation. Instead of this being the case, it was found that the armor wire broke down the rubber insulation, making contact with the high-tension conductor and making it dangerous for any lineman to handle the wire at all.

Mr. Gear closed the discussion with a few words on the operating conditions in Chicago. His company has overcome a good deal of the difficulty of running wires through trees by making poles high enough to clear the tops of the trees. As the trees grew up, they, by careful trimming, were able to avoid most of the trouble. In some cases they had found it wise to put a porcelain sleeve, sometimes as much as two feet long, over the conductor, and this was a very good form of insulation. They were fortunate in Chicago in having an extensive series of alleys, in which it was possible to run for miles in some cases, without any recourse to the open streets.

The meeting then adjourned.

Eighth Annual Dinner of the Brooklyn Engineers' Club.

The Brooklyn Engineers' Club enjoyed its eighth annual dinner in the banquet room of the Oxford Club, Brooklyn, N. Y., on Tuesday evening, December 15, 1903. The menus were novel in design and made to resemble a specification of work to be performed, and were so inscribed, being enclosed in an envelope of legal size. President A. J. Prevost, Jr., was the first to deliver an address; Mr. Henry Sanger Snow spoke on "Professional Training;" Mr. Helmle, "International Improvements;" and Mr. Taylor, "The Professional Man in Municipal Life." Following this business matters were transacted, and Mr. Othniel F. Nicholas was elected president, Mr. John Middleton as treasurer, and Mr. Joseph Strachan as secretary for the coming year. Mr. Prevost, the retiring president, made a brief address of thanks to the club for its courtesy to him in the past year, and bespoke a cordial support to his successor during the coming year.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED FRIDAY, NOVEMBER 20, 1903.

John Patterson Agnew, Wilkinsburg, Pa.
Walter Clymer Barnes, New York city.
Thomas Edson Barnum, Milwaukee, Wis.
Henry Jerome Bildhauser, New York city.
Frederick Edmond Cooley, Schenectady, N. Y.
Charles Louis Crabb, Yonkers, N. Y.
Ernest Edgar Davis, Savannah, Ga.
Roger Dennison De Wolf, Wilkinsburg, Pa.
Albert Esling, Toronto, Ontario.
Michael Birt Field, London, S. W., England.
Clarence Dudley Fitts, Oakville, Ct.
Lewis Alfred Freudenberger, Newark, Del.
Herbert Willard Goddard, New York city.
Roy William Gray, Los Angeles, Cal.
Bernard Charles Groh, Trenton, N. J.
Walter Binkerd Gump, Rumford Falls, Me.
Charles Caesar Hawkins, Bedford, England.
David Carl Henry, Chicago, Ill.
Adolf G. B. Hess, Brooklyn, N. Y.
Edwin George Hindert, Elyria, Ohio.
Robert Milne Hopkins, Evanston, Ill.
Maurice De Hoor-Tempis, Budapest, Hungary.
Charles Henry Hurd, Indianapolis, Ind.
Irving Phelps Keeler, Asheville, N. C.
James Gifford Kellogg, Ithaca, N. Y.
Roger Nelson Kimball, Kenosha, Wis.
Henderson William Knott, New York city.
Rudolph I. Kunze, Yonkers, N. Y.
George Foreman Landers, Fort Totten, N. Y.
Emanuel William Lewis, Pittsburg, Pa.
Alexander Maxwell, New York city.
Samuel Harvey McLeary, Ithaca, N. Y.
Frances Mearson, New York city.
Thomas Lodwick Miller, Liverpool, England.
Jacob Alaric Leo Möller, New York city.
William J. Mowbray, Brooklyn, N. Y.
George Barrows Obear, Lynn, Mass.
Herman Henry Oswald, Schenectady, N. Y.
Bertrand Perry Rowe, Wilkinsburg, Pa.
Burton Mansfield Sawyer, Pittsburg, Pa.
Frederick E. Schmitt, New York city.
Joseph Henry Siegfried, New York city.
Arthur Gaylord Slocum, Jr., St. Louis, Mo.
Julian Cleveland Smith, Montreal, Quebec.
Rex Thomas Stafford, Buffalo, N. Y.
Joseph Brown Stevens, West Lynn, Mass.
Harry Winthrop Turner, Rugby, England.
Harry Casper Walter, West Lafayette, Ind.
James Thomas Whittlesey, Montclair, N. J.
Samuel Thayer Willis, Pittsfield, Mass.
Alfred Wohlauer, Schenectady, N. Y.

THE FOLLOWING ASSOCIATES WERE TRANSFERRED TO THE GRADE OF MEMBERS:

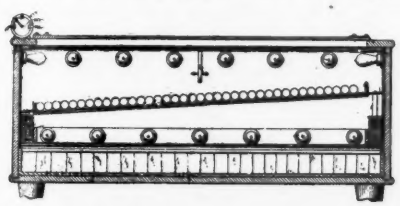
Walter Ambrose Pearson, New York city.
Wynn Meredith, San Francisco, Cal.
Lorin Everett Imlay, Niagara Falls, N. Y.
Bernard Edward Sunny, Chicago, Ill.
John Joseph Carty, New York city.
Eugene B. Clark, Chicago, Ill.

Magnetic Iron Sand in Java.

In the neighborhood of the town of Yjilatjap, on the coast of the island of Java, extensive deposits of magnetic iron sand have been found. The deposits begin opposite the island of Noesa Kembangan and extend about twenty-nine miles to the east along the coast line. The sand lies on the surface and is said to contain in some places as much as eighty per cent of iron. Samples taken in different parts give a very good result when smelted. Some time ago an English company, with a Hollander at its head, acquired the right of exploiting these deposits, which have been known since 1845.

Electrical Patents.

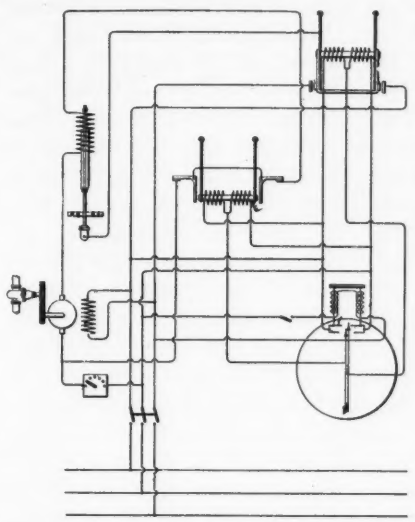
Mr. Frank C. Perkins, of Buffalo, N. Y., is the inventor of a novel electrical incubator, the object of which is to provide an incubator in which eggs are hatched and chicks are kept warm by means of an electric heater, which, together with a thermostatic regulator is arranged directly within the incubating chamber. Another object of the invention is to provide simple automatic means for turning the eggs and also cooling the same periodically. The incubator is furthermore so organized that the eggs may be readily tested without removing the same from the incubator. An incubating chamber is provided in which is arranged an oscillating egg tray which is shifted by electromagnets having their magnets connected with opposite ends of the tray. An electric heater is also arranged in the chamber and is connected on one side with one end of the magnet coils. Arranged in the chamber and interposed between one pole of an electric generator and the heater is a thermostat. A rotary contact arm is connected with the other pole of the generator, and on opposite sides of the contact arm are arranged a pair of magnet contacts which are connected respectively with the opposite ends of the magnet coils. Segmental contacts are arranged around the magnet



Longitudinal Section of Elevation Plan of an Electric Incubator.

contacts and alternate with the same, and are connected with that side of the heater opposite the thermostat. An insulating section is arranged between two adjacent contacts, which are adapted to be successively engaged by the contact arm during its rotary movement.

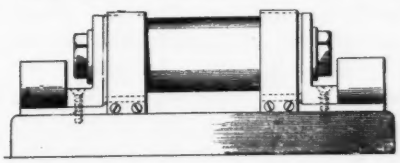
Austin R. Dodge, of Schenectady, N. Y., has recently patented an automatic regulator, which he has assigned to the General Electric Company, of New York. The present invention has for its object to provide a regulator which will automatically maintain a constant pressure on the engine or other apparatus under test, or which will automatically maintain a constant voltage or current on the system when the regulator is employed in connection with electrical apparatus. In carrying out the invention, an electric motor is provided which is geared or otherwise connected to the throttle valve or other device to be actuated. When the motor revolves in one direction, the throttle or other device is opened more or less, and when it revolves



Diagrammatic View of a Motor Geared to a Valve or Other Regulating Device, Together with the Necessary Magnets, Controlling Devices and Circuit.

in the other direction the valve or other device is closed to a greater or less extent. In the case of electrical apparatus the motor is connected to a regulator of suitable character in such manner that the effect on the system or generator is to increase or decrease the current or voltage, as desired. The circuit of the motor is controlled by a pressure gauge or equivalent device, which, acting through electromagnets, starts and stops at the proper time, suitable means being provided to prevent the motor from overtraveling or "hunting," as it is called. Two sets of motor-controlling magnets or devices are provided, one being employed to rectify slight changes in pressure, voltage or current, the other to rectify material changes. The second device is arranged to act on the motor through the first. This is done by rendering the former inoperative until the conditions are approximately normal after which the first comes again into service. The second regulating device, however, may act directly on the motor. In order to stop the motor the instant the desired change in addition is effected, a suitable and additional load is applied to the armature.

An electric fuse or cutout has been devised and patented by Mr. Louis W. Downes, of Providence, R. I., and the patent obtained has been assigned to the D. & W. Fuse Company, of Providence, R. I. The improvements are particualrly applicable to high-capacity fuses, although capable of being employed with fuses of low capacity. Upon a base of porcelain or the like is mounted the fuse terminals. Upon one end of the plate at each terminal rests a casting, comprising a socket for receiving the end of the circuit-conductor, and an upright plate having a notch extending from its centre upward. The casting and plate of the terminal are secured by screws to the base. Upright spring-blades are secured to opposite edges of the terminal plate. A tubular casing is provided, closed at its ends by caps, each cap having an outwardly projecting, hollow, exteriorly screw-threaded stud thereon. The caps are secured to the tubular casing by screws. Movably inserted in the casing is a cartridge fuse, which comprises a sheath composed of a tube, closed at its ends by thin, stamped, sheet metal caps, which are perforated to permit the escape of gases evolved on the blowing of the fuse. When the cartridge fuse is in place in the casing the projecting ends of the fuse link fit closely and are preferably soldered or sweated in the hollow studs of the caps. The cartridge fuse is inserted in its casing by removing one of the caps. After the cap has been replaced and secured the studs are heated and touched with solder, which melts and runs into the small space between the projecting ends of the fuse link and the inner walls of the studs, uniting them both electrically and mechanically. The insertion of this cartridge fuse into the terminals of the live circuit is facilitated by two sets of spring-blades, which make electrical contact with the



Elevation View of a New Electric Fuse or Cutout.

caps and temporarily carry the current while the fuse casing is being adjusted to its final position in the terminals. In this manner blistering or burning of the contact surfaces of the upright plates and at the ends of the caps is prevented. As it is not always desirable or reliable to depend upon the spring blades alone to carry very heavy current, nuts are provided adapted to clamp the end surfaces of the caps into tight and positive contact with the inner surfaces of upright plates, thus relieving the spring-blades of the necessity of carrying any great volume of current. Upon blowing the fuse, the nuts are loosened and the casing withdrawn from the terminals, one or both caps removed, which is readily accomplished as the fuse link has been melted in two at its middle. Sufficient heat is then applied to the studs to melt the solder and permit the ends of the fuse link to be pushed out, leaving the opening clean and ready for the insertion of another fuse link.

Reviews of Current Engineering and Scientific Literature.

The Electric Supply of Calcutta, India.

Calcutta, it is said, has the best electrical supply system in Asia. The generating station is located on Imanbagh lane, and has a total output of over 2,405 kilowatts. The generating sets are eight in number, and consist of Bellis & Willans engines, direct-connected to the generators. The largest generating set is rated at 713 kilowatts, 550 volts, there being two of these, and they are thought to be the largest in the East. The distributing mains, of which there are twenty-three, are laid underground, there being eighty miles of cable. The three-wire system is employed. The station operates night and day, with three shifts of attendants. The price of electrical energy at Calcutta varies, for lighting, from eight annas to three and one-quarter annas per kilowatt-hour. For power, the rate varies from four annas to two annas. In spite of the conservatism of the natives, the use of electrical power is spreading.—*Abstracted from the Indian Textile Journal (Bombay), November* 16.

The Boma-Leopoldville and Leopoldville-Equateur Telegraph Line.

A telegraph and telephone line 1,199 kilometres in length has been constructed in the Belgian Congo settlements, Africa. The first work was from Boma to Matadi, twenty-nine kilometres. It required not less than eight months' construction. The climate is very hard, and most of the work has been carried out by the natives under direction of Europeans. Several difficult streams were crossed. The crossing at Underhill was made by means of two steel pylons, fifteen metres high and 800 metres apart, and placed, respectively, seventy-three and sixty-three metres above the high-water level. The construction of the line from Léopoldville to Equateur was very difficult. Surveys were particularly dangerous and the zone unhealthy. The width of the clearing is twelve metres, and the poles are placed 100 metres apart. In the forest the supports are thirty, forty or fifty metres apart, according to the position of the trees, to which they are attached by means of iron bars. The crossing of the Kasai was the most difficult, as it was necessary to provide for the passage of steamers. Advantage was taken of a rocky island in the river, and the crossing was made in two spans, one of 450 metres and the other of 670 metres, the supports being three iron pylons, 14, 36.5 and 38.5 metres high, respectively. Much trouble was experienced in getting the four conductors in place. This was finally carried out by means of a tug. The line does not suffer from white ants, as the posts are either iron or living trees. On the contrary, they are frequently broken by elephants. Storms occasion great interference by throwing down trees across the line, and atmospheric discharges are also troublesome. Birds make their nests on the wire; wasps nest in the insulators, and spiders cover the poles with web, collecting a litter of leaves and twigs. The line is used both for telephone and telegraph service, and the stations are protected by the local garrison. Numerous branch lines are projected and are in process of construction.—*Translated and abstracted from the Revue de L'Électricité (Berne), November.*

The Radiant Efficiency of the Nernst Lamp.

The radiant efficiency of the Nernst lamp is placed at twelve per cent in Drude's "Lehrbuch der Optik," but this figure seems not reliable. Mr. L. R. Ingersoll has made a determination of the Nernst glower efficiency under varying conditions, using Angstrom's method, and at the same time testing the accuracy of this method. The method consists in dispersing the light radiated from the glower, cutting off with a screen the non-luminous rays, and then, by means of a cylindrical lens, reassembling the visible part, which is balanced photometrically against the total radiation from another exactly similar source. In the arrangement of the apparatus, two glowers were connected in series, the power consumed by each being maintained constant. The radiation from one of these glowers was received upon a concave mirror, reflected upon a movable prism, and after passing through this was, by means of a pair of mirrors, passed through an adjustable screen which could be accurately adjusted to cut off all the non-visible rays. Just beyond this screen was placed the cylindrical lens which recombined the spectrum into a band of white light upon the receiving screen or thermopile, so as to compare it with the radiation from the other glower, the latter being movable, so as to obtain the balance. In addition to this arrangement, a small water cell was used for a time to absorb any stray infra-red rays, but this was found by trial to be unnecessary. Correction was made for selective reflection, for absorption by the glass prism and lens, for inaccuracy in setting the screen, and for the disturbing effects of the instruments and radiation from the surrounding apparatus. It was found in the study of these corrections that the error of the method was about ten per cent. The efficiency of new glowers was found to vary from 4.35 per cent to 4.70 per cent, with a mean of 4.61 per cent. The efficiency falls rapidly for the first twenty hours, decreasing to 4.3 per cent, but varies only slowly after this. This decrease in the efficiency does not agree with the results obtained by Mr. L. W. Hartman, but the discrepancy was thought to be due to the fact that the latter investigator maintained the current constant, and not the power, as was done in this work. Some very old glowers gave efficiencies of only 3.6 per cent. These results were all for 110-volt glowers, consuming eighty-nine watts, and for every watt above eighty-nine, within narrow limits, the efficiency increases 0.06 per cent, and below this, *vice versa*. The energy curve, plotted from Wein's law, gives the efficiency as 4.17 per cent. This lies well within the limits of 2,200 and 2,450, as given by Lummer and Prigsheim.—*Abstracted from the Physical Review (New York), November.*

The Gola Lightning Arrester.

To protect electrical conducting systems against damage due to lightning, two distinct actions may be made use of—first, atmospheric charges may be caused to discharge at a fixed point; and, second, the action of the arrester may depend upon breaking the arc which forms when the line current follows the atmospheric discharge. Nearly all arresters act according to the latter method, and they are connected in parallel with the lines to be protected. The Gola arrester, which is here described by Mr. Attillio Sachs, is, however, a series arrester. The apparatus consists of two concave plates of magnetic material, placed with their concave sides opposing, and connected together at the edges by a non-magnetic metal ring. The plates are oval in shape and are supported upon a strong insulator. Above them, and supported from the upper surface by means of bolts of non-magnetic metal, is a third plate, in shape very similar to the other two and placed with its concave side downward.

Two arms extend from the upper and lower of the three plates, and between them is placed a solenoid, one end of which is connected at part of the line to be protected, and the other to the lowest plate. The line wire is connected to a terminal on the upper plate. There is thus a metallic path from the line wire through the three plates successively, and then through the coil. The latter, however, when a current is flowing, sets up a magnetic field in the two gaps between the three plates. Opposite the edges of the plates are two sets of carbon rods, held in clamps, but adjustable. These are supported on insulators and are connected to the earth. This design of apparatus is intended to present a large surface and suitable discharging gaps, across which atmospheric discharges will take place, due to the magnetic field, but in such manner that the line current will not follow. The discharge points are tipped with non-arcing metal. This form of apparatus, which has been reached after several designs, has been tried in several Italian installations, among them being the Centrale de Bedonia. The lines here pass over a mountainous country, and have been protected by the Gola arresters only. During two seasons the installation has not had a single interruption due to lightning, although there were many storms during this period, and several other installation in the neighborhood which were not protected by these arresters, had great difficulty in maintaining their service during these storms. The author thinks, however, that to assure entire protection from lightning, a combination of the two types of arrester should be used, so as to provide suitable discharge gaps; and at the same time provide for interrupting any arcs which may be formed.—*Translated and abstracted from the Bulletin des Ingénieurs Electriciens (Liege), November* 30.

The Effect of Impurities on Commercial Copper.

A study of the effect of impurity on copper has been made by Mr. Ernest A. Lewis, who here gives a partial report of his work. Impurities in copper are divided into three groups, according to their effect on the microstructure. The first group contains those metals which separate out around the copper crystals in the free state, such as lead and bismuth. The second group contains those metals which alloy with a portion of the copper and separate out around the crystals as an alloy, such as arsenic, antimony, tin, zinc and the non-metals, oxygen, phosphorus and sulphur. This group is again divided, according as to whether the alloy separates into two constituents after it is solidified, or not. The third group contains those metals which dissolve in the copper crystals and do not separate out, but form a solid solution, such as iron, manganese, aluminum and nickel. When pure copper is alloyed with 0.2 per cent of lead or bismuth, after polishing and etching, the crystals of copper are seen to be surrounded with a thin skin of lead or bismuth. These two metals make copper so brittle, when present in small quantities, that it will not roll. Pure copper containing 0.2 per cent arsenic, phosphorus or tin, when polished and etched, is seen to consist of crystals of copper surrounded by a network which can not be resolved into two constituents. Such copper can be rolled and is malleable. Pure copper, containing 0.2 per cent antimony, arsenic or oxygen, when etched, shows a network, but it can be seen that the network contains two constituents. Such copper rolls poorly, cracking at the edges. Pure copper, containing 0.2 per cent iron, manganese, aluminum or nickel, does not show any network. The microstructure is similar to pure copper. A table is given showing the behavior of copper under mechanical treatment, containing various percentages of these impuritics. It is noticed that arsenic has the property of neutralizing, to a certain extent, the injurious effect of bismuth, lead and antimony, and that tin, manganese and aluminum intensify the effect of the impurity. Manganese and aluminum, when present in quantities of 0.5 per cent, are capable of neutralizing the effect of 0.1 per cent of sulphur.—*Abstracted from Engineering (London), December* 4.

Meeting of the Philadelphia Branch of the American Institute of Electrical Engineers.

A meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held on Tuesday, December 8, in the Engineers' Club, Philadelphia, Pa. Mr. Lamar Lyndon read his paper on "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Loads." Mr. E. F. Northrup gave an abstract and discussion of Mr. Addick's paper on "The Electrical Conductivity of Commercial Copper." Professor Joseph W. Richards, of Lehigh University, gave a very interesting and instructive address on "The Energy Absorbed in Electrolysis." The discussion of the papers was interesting and spirited. It was participated in by Messrs. Woodbridge, Blizard, Lyndon, Clauder, Hewitt, Richards, Northrup, Hodges and Sanville. After the discussion Messrs. W. L. Hodges and John Kelly showed the talking arc lamp. The experiment was very successful. A number of phonographic records were given out by the arc, as well as the human voice. The phonograph was operated and the speaking was done in a room remote from that in which the lamp was exhibited.

The American Association for the Advancement of Science.

The annual meetings of the American Association for the Advancement of Science and of the American Physical Society will be held in St. Louis, Mo., in "Convocation Week," from December 28, 1903, to January 2, 1904. The opening session of Section B, physics, will be held on Monday, December 28, after the adjournment of the general session—probably about eleven o'clock A. M. At this time the section will organize, elect committees and transact other suitable business. At four o'clock on the same day the retiring vice-president, Professor Ernest F. Nichols, will give an address on "The Infra-Red Spectrum."

The section will meet on the morning and afternoon of December 29, for the readings of papers. On Wednesday, December 30, the annual business meeting of the American Physical Society will be held, and on this day the programme will consist of papers by members of the society.

A regular session will be held on Thursday morning, while the afternoon will probably be devoted to a visit to the World's Fair grounds.

If the number of papers is sufficient, the sessions will continue through Friday and Saturday.

All sessions for the reading of papers will be held in room 317 of the Central High School building. The vice-presidential address on Monday will be given in room B2.

Professor B. Rutherford, of McGill University, Montreal, Canada, will give a popular lecture on radium, the time and place to be announced later.

The Southern Hotel has been selected as the general headquarters. Hotels for the headquarters of sections have not been announced.

A rather long list of papers has been submitted to both Section B and the American Physical Society, and an attractive and successful meeting seems assured.

Mr. Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, is secretary of Section B, and Mr. Ernest Merritt, of Cornell University, Ithaca, N. Y., is the secretary of the American Physical Society.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A 30,000,000-Candle-Power Beacon.

At the mouth of the river Elbe, in Germany, there has recently been installed at the Heligoland Lighthouse an electric searchlight, which is perhaps noteworthy because of its intensity. This searchlight was built and installed by the Siemens-Schückert Werke, of Berlin, Germany, and has an illuminating intensity of 30,000,000 candle-power. The electrical apparatus was constructed by the Elektricitätts Actiengesellschaft, formerly Schükert & Company, of Nuremberg, Germany.

FIG. 1.—THE ARRANGEMENT OF PROJECTORS FOR THE BEACON AT HELIGOLAND, GERMANY.

FIG. 2.—A NIGHT PICTURE OF THE LIGHTHOUSE AT HELIGOLAND, GERMANY.

The arrangement of the searchlight, as can be seen by reference to Fig. 1, is as follows: there are three lower searchlights arranged 120 degrees apart, and another mounted on top, all operated automatically and driven by means of electric motors. The carbons, which are fed by automatic mechanism, are placed in a horizontal position, as is usual with most large searchlights. The maximum current used is 100 amperes.

The light flashes occur every five seconds and they remain in one position only a tenth of a second. The three lights, mounted 120 degrees apart on the lower revolving platform, have mirrors twenty-nine inches in diameter and utilize a direct current of twenty-four amperes each, this platform revolving at the rate of four revolutions per minute.

Fig. 2 shows the lighthouse as it looks at night, and Fig. 3 shows the famous lighthouse at Heligoland, Germany.

FIG. 3.—THE LIGHTHOUSE AT HELIGOLAND, GERMANY.

The Wireless Railway Company.

The Wireless Railway Company has been formed to exploit the Pullen patents on a surface-contact system of electric car propulsion. This system is in operation on a branch track at Atlantic City, N. J., and has been visited by a number of interested investors and electric railway people.

This system is the invention of Mr. Leon W. Pullen, and the object of his invention is to provide means adapted to both new and existing railways, for operating an electric car from a circuit which is completed only at points adjacent to the car as it travels over the working or supply conductor or contact blocks. By this method the supply conductor may be enclosed or protected beneath the roadbed, and the contact block upon the surface put into electric circuit with the supply conductor only when and during the time the car is over the contact block.

The roadbed is provided with a series of specially constructed tubular armatures, adapted to be energized by magnets upon the car, and by which they will close automatically for a period corresponding to the time the car is over them. The car is provided with electric motors to propel it, and with magnets for operating the tubular armatures; and is further provided with a long-travel contact shoe or collector, which makes contact with the contact blocks along the track.

A New Lock Push Switch.

The Hart & Hegeman Manufacturing Company, Hartford, Ct., is placing on the market a new form of push switch which is a departure in this apparatus. The accompanying illustrations show the assembly of the switch and also a diagram of the mechanism.

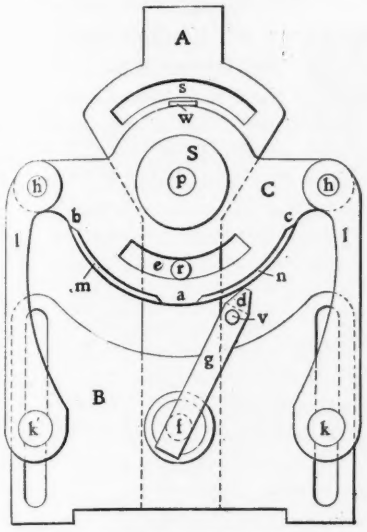


FIG. 1.—A NEW LOCK PUSH SWITCH. DETAILS OF OPERATION.

This switch is intended to be operated only by a person having a key which will fit it. Its appearance, when fully assembled, is very much the same as that of an ordinary push switch. It is impossible, however, to manipulate it unless the keys are in the possession of the operator. When the switch is worked, the key must be inserted in the button, and this, engaging with a lug on an ingeniously constructed lever, performs the operation of the ordinary push-button.

The switch is illustrated by the accompanying Figs. 1, 2, 3, 4 and 5.

The mechanism of this switch is somewhat complicated, and a reference to the diagrams will be necessary to understand the operation. Fig. 1 is a plan view of a portion of the mechanism. This portion, as will be understood from the description, is not in normal position. Fig. 2 is a view of the switch blade, bottom side up. In assembly, the switch blade would be turned over, the hole *p*, in Fig. 2, fitting on the shaft *p*, in Fig. 1. The slide *u*, in Fig. 2, would engage with the pin *v*, in Fig. 1.

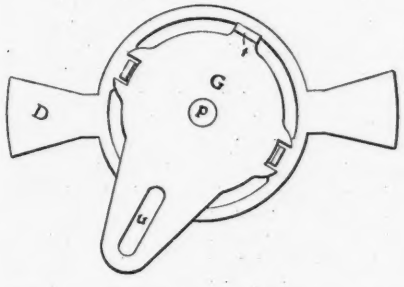


FIG. 2.—A NEW LOCK PUSH SWITCH. THE SWITCH BLADE.

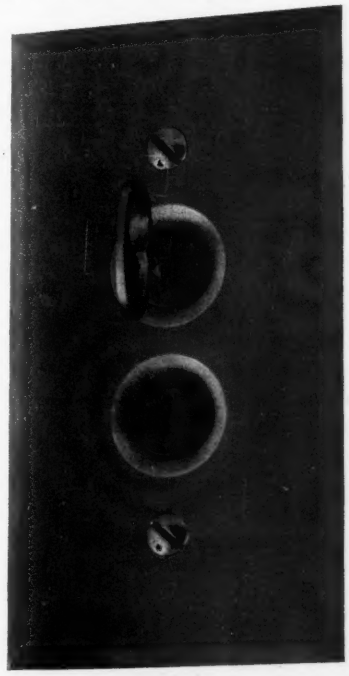


FIG. 3.—THE LOCK PUSH SWITCH, WITH FACE-PLATE, ASSEMBLED.

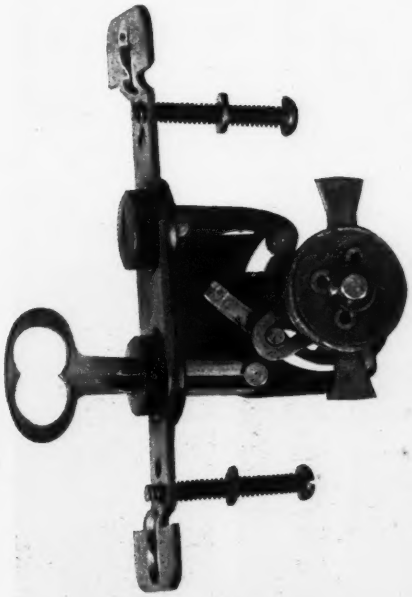


FIG. 4.—THE LOCK PUSH SWITCH, SHOWING DETAIL OF MECHANISM.

Referring again to Fig. 1, the parts *g* G form a sort of toggle joint, the pin *v* working in the slot *u*. All of these parts are fastened rigidly together, and are held in tension under the action of a spiral spring *s*, which works on the shaft *p*. Both ends of this spring press on either side of the fingers *w*, projecting upward in Fig. 1, and *t* projecting downward in Fig. 2, which work one inside the other, the motion of *t* being limited by the slot *s*; and the motion of *w* by the stop *r* in the slot *e*. The lever *g* has a lip *d* projecting downward at one end. This lip rests against the guards *m* and *n*, which are turned up on the portion C, and slotted at *a*, *b* and *c*.

When the key is inserted in one of the buttons, it is pressed against a stud *k'*, on the link *l'*. This turns the part C to the right. The finger *t* is stationary so long as the lip *d* is restrained from moving the guard *n*. The finger *w* moving with the part C puts the spring on the tension, the other end of the spring being held by *t*. When the part C is turned as far as it will go to the right, the lip *d* escapes at the guard *c*, passing back of it and out at *a*; then resting against the guard *m*. As soon as the lip escapes the guard, the spring is released, and the blades D fly over, opening or closing the circuit, as the case may be, by passing into engagement or out of engagement with the switch jaws. These are shown in Fig. 5. The same cycle of operations is performed if it so happens that the key must be inserted in the other button.

The switch blade D is made of one continuous piece of brass, which is insulated from the mechanism by sheet mica.

This apparatus is contained in a porcelain box, this box holding the switch jaws. The wires are brought up outside of the porcelain, and ample assembly room is made for contact. The switch is finished with a handsomely nickel-plated flush-plate, making a decidedly ingenious and efficient piece of apparatus.

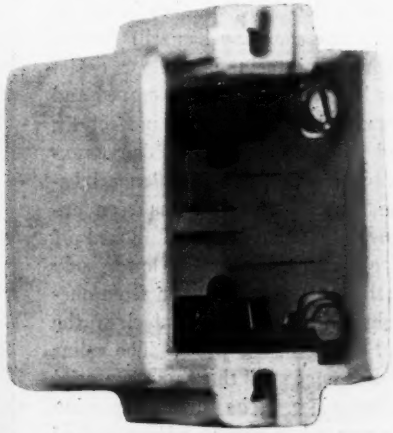


FIG. 5.—THE PORCELAIN RECEPTACLE AND SWITCH JAWS, LOCK PUSH SWITCH.

The New "G. I." Floor Outlet Box.

In modern electrical construction work there is a growing tendency, year after year, to place electric light, telephone and bell wires in iron conduit, and the need

FIG. 1.—FLOOR OUTLET BOX.

of first-class floor outlet boxes has long been felt by engineers and architects who aim for high-grade work and endeavor to protect their clients against future trouble with broken circuits, interrupted service, or possible fires through poorly designed or faulty floor outlet boxes. Floor outlet boxes have often been the weakest points of a wiring installation, being exposed to water and dirt when floors are swept or scrubbed, and, from the nature of their location, are subjected to hard usage. The engineers of the General Incandescent Arc Light Company, it is said, were the first to design and patent a universal, interchangeable floor outlet box, which is at all times water-tight, whether in use or not. The company has still further improved its standard floor outlet box by having all parts stamped and drawn, thus ensuring a perfect fit, and reducing the weight. The manufacturer states, that the General Incandescent outlet box has been approved by the National Board of Fire Underwriters. The lower body of the outlet box is drawn from one-eighth-inch cold rolled steel of the best grade, in one piece. The collar is also made of the same material in one piece. The threaded portion is arranged to give an adjustment of one inch, so that the depth of the box may be lengthened from four inches to five, and remain perfectly level after once being set in position. The top plate is made of heavy brass and is fastened to the iron collar, a rubber gasket being placed between, which ensures a water-tight connection. This floor outlet box is especially adaptable in construction work, for electric lights, electric fans, push-buttons or telephones located on tables, desks, counters or showcases, as will be observed by referring to Fig. 2. The manufacturer claims it has the following features which will be appreciated by engineers and construction men: It is strong and substantial and will not sink in the floor when subjected to heavy weight. It is thoroughly dust and waterproof. It is adjustable with respect to floor level, saving wiremen's time. Adjustment can be made after floor is laid. It is accessible after being installed, the parts being held together by standard machine screws. It is not liable to injury for the reason that the flexible cord comes from the side of the outlet nozzle, where it can not be stepped on and the insulation crushed or injured. It is not necessary to detach cord when floors are swept or scrubbed. When not in use a brass plug can be screwed into floor-plate, making it water-tight and flush with the floor. If it is desired not to use unsightly cords from nozzle at floor level, one-half inch plain iron conduit, or conduit encased in polished brass tubing, can be screwed into the one-half inch gas pipe thread in the floor-plate and extended to the under-side of desk, table,

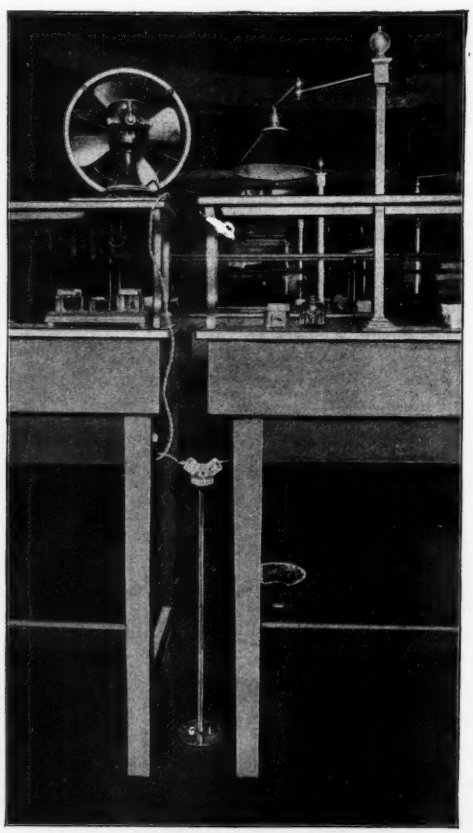


FIG. 2.—FLOOR OUTLET BOX PLACED BETWEEN DESKS.

counter or showcase. When placed between two or more desks or tables, as shown in Fig. 2, a two, three or four-outlet cluster can be attached to the pipe extension and connected by two or more flexible cords and Edison attachment plugs for operating electric fans or lights on two or more desks.

The exposed portion of the box has a polished brass finish, and the steel body is heavily japanned inside and out.

New Types of Voltage Regulators for Generators.

Recently there have been placed on the market two new types of voltage regulators which admirably suit the conditions for which they were designed. They are known to the public as type TD and type TA. Type TD regulators (Fig. 1) are designed for direct-current generators only, while type TA (Fig. 2), though primarily designed for use with alternating-current generators, may, if provided with an exciter, be used on direct-current generators as well.

These instruments operate on the principle of rapidly opening and closing a shunt circuit across the field rheostats, the rheostats having considerable resistance turned in to give the regulator a good margin to work on. The type TD regulators are arranged to open and close a shunt circuit across the generator field rheostat; type TA across the exciter field rheostat.

Direct-current regulators, type TD, consist of a main control magnet and relay. The relay is differentially wound, one of these windings being permanently connected to the circuit, while the other is opened and closed by the main contacts which are operated by the main control magnet. As the main contacts are opened and closed, they simultaneously open and close the relay contacts by means of the differential winding of the relay. These relay contacts open and close a shunt circuit across the generator field rheostat. To prevent injurious sparking at the relay contacts, condensers are connected in multiple across them. This regulator will maintain constant voltage on one shunt-wound generator, or will maintain constant voltage on several compound-wound generators operating in parallel, regulating, however, only one at a time. Several generators can be arranged to be controlled by one regulator, by means of the five-point rotary switch as shown in Fig. 1. The generator being regulated has a tendency to take the sudden fluctuations of load, but it is quickly equalized between the several generators by means of the compound winding of the machines. With shunt-wound generators it will be necessary to have a regulator for each generator to be regulated. These regulators are usually arranged to maintain constant voltage at the bus-bars, but may be connected to pressure wires brought back from the

centre of distribution, thus maintaining constant voltage at the centre of distribution.

Elementary connections of this regulator are shown in Fig. 3. Type TA regulators are designed to maintain a steady(but not a constant) exciter voltage, and consists of the same direct-current control magnet and relay as the type TD, with the addition of an alternating-current control magnet having a potential and an adjustable compensating winding. These two windings work in opposition to one another. This magnet operates the lower main contact. The magnet core and lever are arranged by means of a counterweight to come to a balance at the correct voltage. Should the alternating voltage tend to vary for any cause, it would change the position of the lower main contact, which would cause the exciter voltage either to be raised or lowered, thus overcoming the disturbing factor. Without the use of the compensating winding, the regulator will maintain a constant bus-bar voltage, and by the use of the adjustable compensating winding and current transformer in the circuit to be regulated, the regulator will automatically compensate for line losses. The alternating voltage is automatically kept at its desired value by varying the exciter voltage. Once the regulator is adjusted to maintain constant voltage at the centre of distribution, it will require no further adjustment and the station voltage will be increased or decreased with the load to automatically maintain the desired voltage at the centre of distribution.

This regulator is independent of temperature and frequency changes. Elementary connections are shown in Fig. 4.

These regulators are switchboard instruments in design and finish, and may be placed on the front of a switchboard panel or be placed at either end of switchboard on rigid iron brackets made for that purpose.

The great value of these regulators will be recognized in their maintaining the desired potential on a system, regardless of variations of speed and load. It naturally results in reduced attendance at the switchboard, increased output of station and reduced lamp renewals due to perfect regulation. These instruments have proven satisfactory is shown by the fact that there are now in service regulators controlling upward of 100,000 kilowatts of generating apparatus and giving full satisfaction.

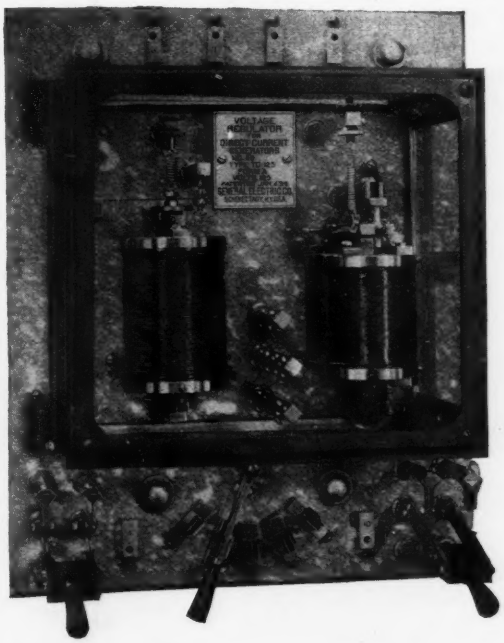


FIG. 1.—VOLTAGE REGULATOR FOR DIRECT-CURRENT GENERATOR.

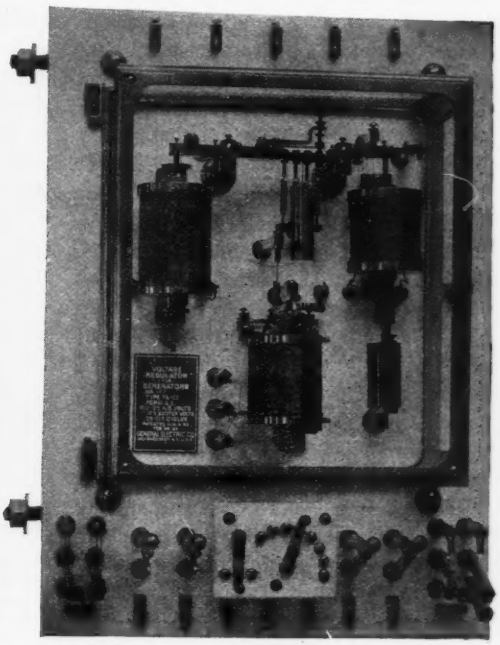


FIG. 2.—VOLTAGE REGULATOR FOR EITHER ALTERNATING OR DIRECT-CURRENT GENERATOR.

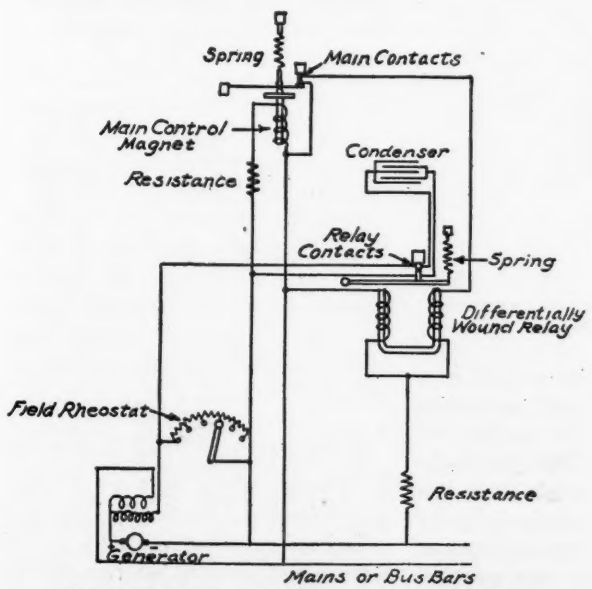


FIG. 3.—ELEMENTARY CONNECTION OF REGULATOR.

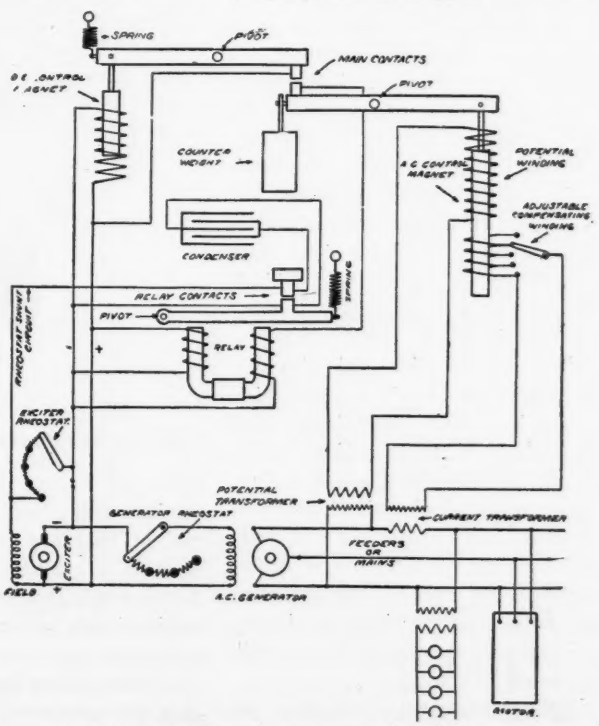


FIG. 4.—ELEMENTARY CONNECTION FOR REGULATOR.

Automatic Block Signals for Electric Railways.

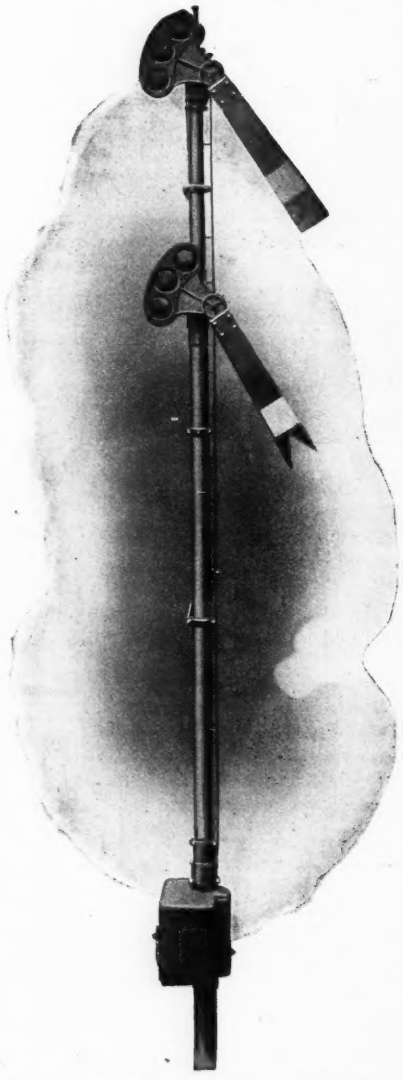
On Friday, December 18, the practical working of the automatic block signal system for electric railways, devised by Mr. S. M. Young, was shown at Rochester, N. Y., to a party of railway engineers, and representatives of the technical papers.

The system has been installed on a section of the Rochester & Sodus Bay Electric Railway at Float Bridge, N. Y. The section of the road selected is about half a mile long, includes a steep grade, and is exposed to unfavorable conditions, the idea being to make as complete a test of the reliability of this system as possible. The rails on this part of the road are frequently covered with snow, and mud and ice have to be contended with, but these, it is said, give no trouble. At the time of the demonstation, the track was filled in with snow.

The apparatus worked perfectly during the demonstration, setting the semaphore at danger whenever the car entered the block, and setting it at clear immediately upon its leaving the block. The system is entirely automatic, the semaphore being set by the car as it enters and leaves each block. Arrangement is also made so that in case of a breakdown of the system at any point the semaphore will be held at danger until the fault is rectified. The system is extremely simple; it is independent of the number of cars on the block, holding the signal at danger until the last one has left, and it allows the full conductivity of both rails to be utilized for the return circuit. Automatic block signals, as installed on steam railroads, require that the track shall be cut into sections, insulated from each other, each section representing a block. At the one end of each section a source of power is installed, connected to the two rails. At the other end, also connected across the rails, is a relay which, when there is no train on the block, holds the semaphore local operating circuit closed, and the semaphore stands at clear. The presence of a single pair of wheels on this section short-circuits the two rails, thereby throwing the relay out of action, and consequently opening the operating circuit and setting the signal at danger, where it remains as long as the two rails are connected by a train.

A simple arrangement of this kind can not be used for an electric railway, unless the use of the track as the return circuit is abandoned. However, the system may be operative by leaving one rail continuous and dividing the other into sections corresponding to the blocks. This, of course, prevents the insulated rail from being used as a part of the return circuit, and may necessitate the use of copper in the return circuit to make good for the loss of the rail.

In the Young system, both rails are utilized for the return circuit, each section being connected to the two adjacent



HOMING AND DISTANT SIGNAL, AUTOMATIC BLOCK SYSTEM.

sections with a bond of high conductivity; and at least one cross bond per section is installed, connecting the section rail to the continuous rail. Thus, due to the section bonds and cross bonds, there is a continuous path of low conductivity for the current taken by the cars, and the two rails are maintained at the same potential by the cross bonds. This, however, is the case only for the direct current returning from the cars, as the construction of the bond is such that an alternating difference of potential may be maintained beneath them.

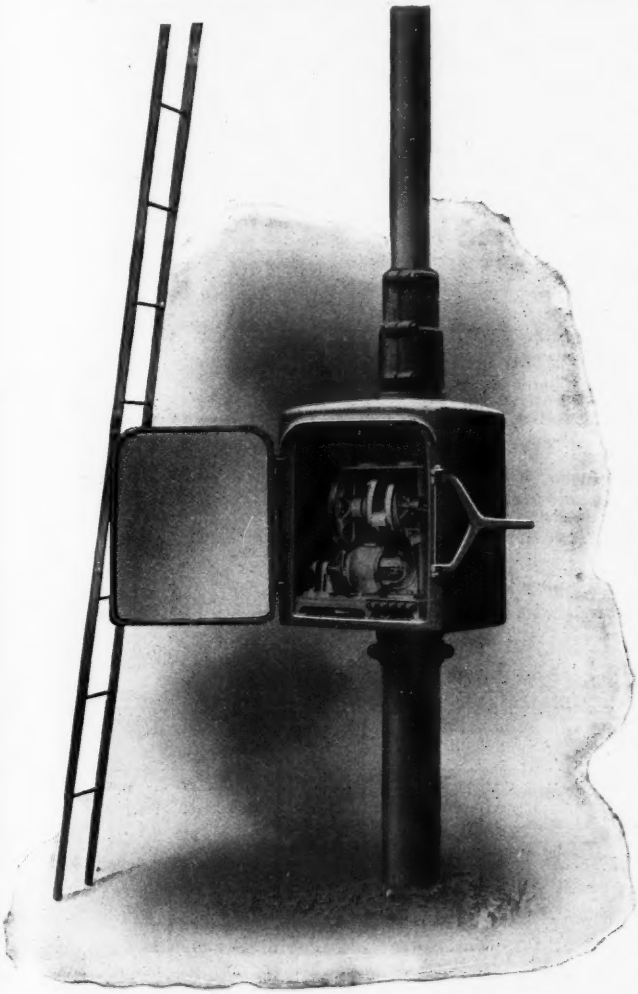
Referring to the diagram, X and Y are the rails, X being divided into sections corresponding to the blocks. IJ is the insulating joint, and B1 and B2, the bonds connected around the insulating joints and cross-connecting the two rails. L is a line wire supplied with an alternating current from a generator at the power-house, the continuous rail forming the other side of this circuit. At one end of each section a transformer is installed, the primary of this being connected between the line L and the rail Y, and the secondary across the two rails. At the other end of each section a special type of relay R is placed, connected across the two rails. At this point is placed the semaphore and the means for operating it. This apparatus may be of any type, provided it can be controlled electrically.

Under normal conditions, when there is no car on the section 2, the relay R will be acted upon by an alternating potential from the secondary of the transformer T'. This, as seen in the diagram, closes the local circuit containing the batteries B, and thus holds the semaphore S at clear. As soon as a car enters the block 2 the rails are short-circuited by the wheels, the relay opens by gravity, and a counterweight sets the semaphore to danger. As soon as the car leaves the section, the relay again closes the local circuit, showing a clear track.

The operation of this system depends upon two special pieces of apparatus—the bonds and the relay. These bonds are merely high conductivity bonds containing a reactance. They thus offer no resistance to the flow of continuous current, but choke back the alternating signaling current. The frequency used in the demonstration was 100 cycles per second, the line being supplied from a 300-volt generator. The power taken is very small; transformers step down the pressure to three volts across the rails, and but a quarter of a volt is necessary to operate the relay. This small voltage, however, must be supplied at a given frequency. As the power is small, a wire about No. 10 is all that is necessary for the line L.

A relay for this system must not only be operated surely by a low voltage of proper frequency existing between the two rails, but it must not respond to any other difference of potential, whether due to the direct current flowing in the rails or to an accidental supply of alternating current of a different frequency. Thus, the rapid starting of a car on the block might

send a momentary impulse through the relay, but this should not affect it. In construction the relay is similar to a shunt motor, with a drum armature containing but one coil. The field is supplied from the primaries of the small transformers,



Operating Mechanism, Automatic Block Signal Switch.

and the armature is connected across the rails. The armature is counterbalanced so as to hold the relay contact open, except when there is a current flowing through its field and another flowing through its armature, of the same frequency. Under this condition, a torque exists between the alternating field and the current in the armature coil. This closes the relay contact and sets the signal to clear. The field and armature cores are, of course, laminated.

In signal engineering, for a system to be considered, it must meet rigid requirements. Thus, the signal must go to danger whenever any part of the apparatus breaks down, and must remain so until this condition is remedied. Examining the Young system in detail, it will be seen that a break in either armature or field circuit of the relay will set the signal to danger. A break in either rail would open the supply circuit, with the same result; as will also a break in the alternating-current supply, due to a fault in the line or a breakdown of the transformer. It is also necessary that a breakdown of the insulating bond should hold the signal to danger. To secure this condition, the secondaries of the signal transformers T and T′ are connected in opposite directions to alternate sections of the track. If, then, a joint breaks down, say at the station S, the relay will be held open by the transformer T, which is not only closer to the relay R than the transformer T′, but acts with the counterweight against T′. Thus, it will be seen that the only apparatus required in this system, in addition to any signaling device which may be controlled electrically, is a small alternating-current generator and a light line extending continuously along the road to be protected; the small transformers and the special relay, one of each being required for each block; and the special bonds, each section requiring at least two—one for a cross bond, and one for a bond around the insulating joint. The system is applicable to alternating-current railways as the frequency of the power supply will differ from that of the signaling circuit and the relay will not respond to any current passing through its armature unless the frequency is the same as that of the signaling circuit.

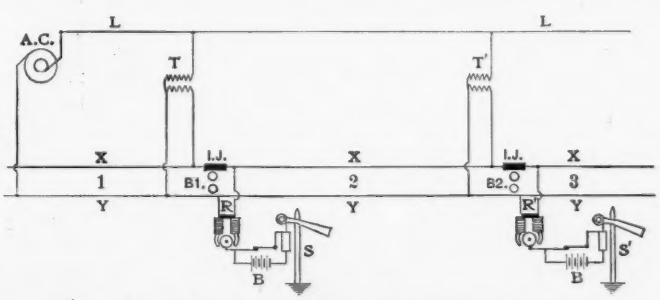
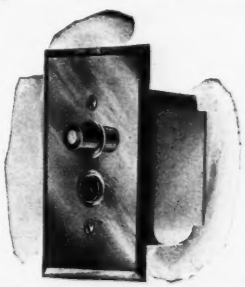


Diagram of Circuit, Automatic Block Signal System.

In the system as installed at Rochester, the electric motor signal of the Pneumatic Signal Company, of Rochester, was used, though any electrically controlled system might have been employed. This company also controls the American rights for the Young system. This signal is operated by a small electric motor contained in a case attached to the semaphore pole, and power is supplied to the motor from a local storage battery, so as to be independent of the line current. This battery is of low voltage, so as to avoid objectionable sparking at the relay contacts. It is charged continuously by a small current drawn from the line through incandescent lamps used as resistance. Incandescent lamps not only furnish a cheap and convenient form of resistance, but they are made use of to give a position, as well as a color, signal at night. There are ten lamps mounted on the semaphore arm, five white and five red, the white being lighted when the signal stands at clear, and the red when it is at danger.

A New Key Push-Button Switch.

The accompanying illustration shows a new key push-button switch which is being



Key Push-Button Switch.

placed on the market by the Marshall-Sanders Company, of Boston, Mass. This is made upon the well-known lines of the M-S push-button switch, but with the added feature of the key, which prevents the switch from being tampered with by unauthorized persons. These switches can be used in asylums, public halls, etc., where it is not desirable to have them operated by any but the properly authorized persons.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TELEPHONES IN CUBA—The Senate at Havana, Cuba, has passed a bill granting a concession to the Compania Nacionale, an American concern, for the installation of long-distance telephones. There was some opposition to the granting of the concession on the ground that the company would come into competition with the government telegraphs.

INCANDESCENT LAMPS FOR THE LOUISIANA PURCHASE EXPOSITION—The contract for incandescent lamps for the Louisiana Purchase Exposition provides for 300,000 incandescent lamps. In the Palace of Education alone there will be installed 12,000 lamps. Mr. E. B. Ellicott is acting chief electrician and mechanical engineer. He is on leave of absence from his post as city electrician of Chicago, Ill., pending the return of Mr. Henry Rustin, chief electrician and mechanical engineer, who is now in the Adirondacks undergoing treatment for his health.

LAKE SUPERIOR COMPANY SALE—The assets of the Consolidated Lake Superior Company, which were pledged with Speyer & Company as collateral for a loan of $5,050,000, were sold at auction at noon December 15. The assets were bid in by Edward C. Henderson, of Guthrie, Cravath & Henderson, representing Speyer & Company. The price paid was $4,500,000. As soon as the list of securities to be sold had been read notices were served by various interested parties protesting against the sale. The Stanley Electric Manufacturing Company, of Pittsfield, Mass., served notice that it was the owner of the machinery in the electric lighting plant in the Michigan Lake Superior power-house. The notice stated that the machinery had been placed with the company, the Stanley Electric Manufacturing Company reserving all rights thereto until the purchase price should have been paid. The purchase price, $60,000, it was stated, has not been paid.

PROGRESS ON CONNECTICUT POWER ENTERPRISE—The project of installing the equipment for transmitting electricity from the New Milford Power Company's plant at Bulls Bridge on the Housatonic river, in Litchfield County, to Waterbury, New Britain and Cheshire to operate the traction and lighting properties of the Connecticut Railway and Lighting Company is being rapidly pushed. This is the biggest power enterprise ever undertaken in Connecticut. The distance from Bulls Bridge to Waterbury is over thirty miles, and to New Britain and Cheshire it is considerably greater. Six cables, each containing seven wires, will be used in transmitting the current. The cables form two lines of transmission wire, the poles paralleling each other at a distance of about twenty-five feet. The wires are of aluminum. Distribution power plants are being built at Waterbury, Cheshire and New Britain. It is expected that the new power system will be in partial operation early in the new year, but it will not be entirely ready until summer. The contract by which the New Milford company is to furnish power to the trolley combine is to run for a period of thirty years.

TIME SIGNALS AROUND GLOBE—The United States Naval Observatory has announced the details of its scheme to send telegraphic time signals throughout the world to mark the beginning of the new year. The signals were sent out last year for each of the four great standard time belts of the United States. This year it is proposed not only to secure a wide distribution of these new year signals throughout North and South America, by the cooperation of the telegraph and cable companies, but also to send one or more of the four series of signals around the world and back to the room in the Naval Observatory where they started. The signals will begin at 11.55 P. M. and end at midnight, eastern time. The same series will be sent out an hour later, ending at midnight, central standard time; again an hour later, ending at 2 A. M., for midnight of mountain standard time, and again an hour after that, ending at 3 A. M., for midnight of Pacific coast standard time. During each of these four five-minute intervals the transmitting clock will send an electric impulse practically every second. On the world circuit the signals will go by land lines to Cape Canso, N. S., thence by cables to the Azores, Lisbon, Gibraltar, Malta, Alexandria and Port Said; by land to Suez, by cable to Aden and Bombay, by land to Madras, by cable to Penang, Singapore, Saigon, Hong Kong, Manila, Guam, Midway, Honolulu and San Francisco, and by land back to Washington. It is proposed to receive both the outgoing and incoming signals on the same chronograph at the Naval Observatory, and thus preserve a permanent graphic record of both on a single sheet of paper. It is suggested that, besides demonstrating the possibilities of practical astronomy and telegraphy, working together through international cooperation, benefits will result from the general attention that it will direct to the advantages of the use of accurate standard time throughout the world. The messages also will carry a new year's greeting to the world.

TELEPHONE AND TELEGRAPH.

HARRISBURG, PA.—A charter has been issued to the Montour Telephone Company.

CHAMPAIGN, ILL.—The new farmers' telephone line to Pickettsville is in operation.

MOOSUP VALLEY, CT.—The telephone line will be extended from Coventry to Moosup Valley.

PUTNAM, TEX.—C. V. Marten has bought the telephone exchange of Putnam from W. A. McCreight.

SCHENECTADY, N. Y.—The Hudson River Telephone Company has moved to its new building in this city.

WARREN, OHIO—The Jefferson & Warren Telephone Company will establish a telephone exchange at Bristolville.

CARBONDALE, PA.—The Northeastern Pennsylvania Telephone Company will build a line from Tirzah through Welsh Hill to South Gibson.

SARASOTA, FLA.—The new telephone exchange is completed, and Sarasota is connected with Tampa, Bradentown, Palmetto and other towns.

BUFFALO, N. Y.—The Commercial Telephone Company has been incorporated with a capital of $50,000, to do business in Erie and Cattaraugus counties.

JOANNA, PA.—The Conestoga Valley Telephone Company intends to rebuild its line from Joanna to Morgantown, using heavier poles to carry the wires.

ALBANY, N. Y.—The New York & Northern Telephone Company has petitioned the city for a franchise to construct and maintain telephone and telegraphic services.

HOLLY BEACH, N. J.—The borough council has passed an ordinance granting the Eastern Telephone and Telegraph Company permission to string wires in the streets of this place.

WILLIAMSPORT, PA.—The telephone line through the Nippenose valley is now completed and in operation. It is a part of the system of the United Telephone and Telegraph Company.

TOLEDO, OHIO—Under the new organization of the business of the Central Union Telephone Company in Ohio, the office of the general division superintendent will be at Columbus, and division offices will be established at Toledo, Chillicothe, Dayton and Akron.

ONTARIO, CAL.—The Home Telephone Company has presented an application to the city trustees for a telephone franchise to run for fifty years. It is provided that after five years two per cent of the gross earnings of the company shall be paid to the city each year.

WEBSTER CITY, IOWA—D. C. Chase, of this city, and a number of other business men are organizing a stock company for the purpose of taking over the lines and franchise of the Stratford Independent Telephone Company, and putting in a second telephone system and exchange in this city.

OBITUARY NOTICES.

HERBERT SPENCER, the famous author and philosopher, died on the morning of December 8, at his home in Brighton, England. Herbert Spencer was the son of a schoolmaster of Derby, England, and was born on April 27, 1820. At seventeen, after a private education, he took up railway engineering and followed this profession for eight or nine years. He was a prolific writer on philosophical subjects, and one of the leaders in thought and literature on the new subject of psychology.

SIR FREDERICK BRAMWELL, F. R. S., died on Monday, November 30, 1903. He was born in London, England, on March 7, 1818. When he was sixteen years of age he went as an apprentice to one of the old schools of mechanical engineering. After a varied experience he commenced practising on his own account as a civil engineer in 1853, and the following year became a member of the Institution of Mechanical Engineers. He was elected an associate of the Institution of Civil Engineers in 1856 and in 1862 attained full membership. In 1874 he was chosen president of the Institution of Mechanical Engineers. As president of the Institution of Civil Engineers in 1884, he described in his address the chief factors of past progress, and advocated the treatment of large steel forgings by hydraulic pressure instead of steam hammers. He was president of the mechanical science section of the British Association in 1872, and again in Montreal in 1884. He was elected president of the Association for the Bath, England, meeting in 1888, when he delivered an address on the greatness of the work which the engineer creates out of minute beginnings. In 1873 he was elected a fellow of the Royal Society. In 1881 he was appointed member of the Ordinance Committee. After serving on the council and as a member of the board of management he was (on the retirement of Sir William Bowman in 1885) made honorary secretary of the Royal Institution. On the foundation of the City and Guilds of London Institute he was appointed by the Goldsmith's Company one of its representatives on the governing body. A knighthood was conferred upon him in 1881, and a baronetcy in 1889. He received the honorary degree of D. C. L. from the universities of Oxford and Durham, and that of LL. D. from Cambridge and McGill.

MR. THOMAS CYPRIAN FRENYEAR, sales manager of the new Canadian Westinghouse Company, died of typhoid fever at Fort William, Canada, on December 10. He was a man of exemplary life, unusual business judgment and ability, and was remarkable for the clearness and force of his ideas. As an electrical engineer he was a good adviser. His is the first death in nearly five years among the higher officials of the Westinghouse Electric Company. Mr. Frenyear was the son of the Rev. T. C. Frenyear and was born on March 16, 1865, at Middletown Spa, Vt. He began his business career before he was fifteen years old, in the office of the Boston Electric Company, where an uncle, Mr. W. R. Nutting, was manager. While there he entered the Latin School, doing his studying at night. From there he entered Phillips Exeter Academy, paying his way by keeping a bookstore for students. He was graduated in 1885. He entered Harvard that autumn, but could not spare time from business to continue the course. He afterward entered the Boston University, but a business reverse put an end to his efforts to gain a collegiate degree. For several years after that he was in the employ of the Thomson-Houston and Brush Electric companies as a salesman, with his headquarters in Buffalo. From 1892 to 1895 he was superintendent of the Cayadutta Electric Railroad. In the fall of 1895 he entered the employ of the Westinghouse Electric and Manufacturing Company. He was connected with the sales office of that company until November 1, 1903, when he was placed in charge of the sales department of the new Canadian company, with headquarters in Toronto. He was married to Miss Emma L. Chase, of Exeter, on June 28, 1893. Mrs. Frenyear and three children survive him. Mr. Frenyear was a deacon and trustee of the Delaware Avenue Baptist Church, of Buffalo, and had been superintendent of the Sunday-school. In announcing the death to the officials of the Westinghouse company, Vice-President Taylor said: "The management desires to place on record its thorough appreciation of his able and loyal service and of the loss to the Westinghouse interests by the untimely removal of a young and zealous official, whose future seemed so full of promise."

ELECTRICAL SECURITIES.

Considerable strength was shown in the stock market developments of last week, and several net advances were made in leading issues. This investment advance in prominent issues strengthens the hope that popular investment is again taking hold of the market. Notwithstanding the pessimistic rumors which emanate from the bear headquarters, there is apparent a firm undertone which bids fair to carry the stock market over the holidays and maintain the present increase in prices. The money market during the week was much easier, and the bank statement of Saturday was more favorable than has been known for some time.

November exports amounted to $160,455,000, as against $125,200,000 for November, 1902. The imports were $77,000,000, against $85,300,000 for last year. The excess of exports over imports was $83,300,000, as compared with an excess in November, 1902, of $39,800,000. For the eleven months of the year, the exports amount to $1,284,000,000, against $1,212,000,000 for the same period last year. The imports were $917,000,000 this year, against $874,000,000 last year. The excess of exports over imports for the eleven months amounts to $392,000,000, against $337,000,000 last year for the same period.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 19.

New York:	*Closing.*
Brooklyn Rapid Transit	50
Consolidated Gas	188⅞
General Electric	165½
Kings County Electric	178
Manhattan Elevated	141⅝
Metropolitan Street Railway	121¾
New York & New Jersey Telephone	147
Westinghouse Manufacturing Company	185

The regular quarterly dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Company will be paid January 15, 1904. Books close December 24 and reopen January 16.

Boston:	*Closing.*
American Telephone and Telegraph	126
Edison Electric Illuminating	218
Massachusetts Electric	75
New England Telephone	122
Western Telephone and Telegraph preferred	81

The transfer books of the Boston Elevated Railway Company will be closed from December 23 until January 5, for the annual meeting.

The directors of the American Telephone and Telegraph Company have declared a regular quarterly dividend of 1½ per cent and an extra of ¾ per cent. The dividends are payable January 15 to stockholders of record December 31. Transfer books close January 1 to January 15, both days inclusive. The company's instrument statement for the month ended November 20 shows gross output of 96,963, and 32,297 returned, leaving net output of 64,666, as compared with 56,649 for 1902. Since December 20, 1902, the gross output has been 1,020,941, and the returned 441,013, the net output being 579,928, as against 573,740 for the preceding year. The total number now outstanding is 3,730,248.

At the annual meeting of the Massachusetts Electric Companies the stockholders voted to accept the annual report as submitted. S. Endicott Peabody, Philip Dexter, Everett W. Burdett, Philip L. Saltonstall and E. Rollins Morse were reelected trustees for three years.

Philadelphia:	*Closing.*
Electrical Company of America	8
Electric Storage Battery common	54
Electric Storage battery preferred	54
Philadelphia Electric	6
Union Traction	45½
United Gas Improvement	84⅜

Electric Storage Battery directors have declared a regular quarterly dividend of 1¼ per cent on the capital stock, payable January 2. Books close December 24 and reopen January 2.

Chicago:	*Closing.*
Chicago Telephone	123
Chicago Edison Light	144½
Metropolitan Elevated preferred	54
National Carbon common	17½
National Carbon preferred	90
Union Traction common	6
Union Traction preferred	29

It is stated that the local elevated railroads will show the largest percentage of increase this month of any month during the year.

PERSONAL MENTION.

PROFESSOR LUDWIG BOLTZMANN has been elected honorary member of the Moscow Academy of Science, Moscow, Russia.

MR. FRANK T. CRAVEN has resigned his position with the C. J. Field Conduit Company, to represent the American Conduit Company, New York city, N. Y.

MR. ALFRED G. HEGGEM, who has been located as consulting engineer at Massillon, Ohio, has opened offices for the practice of his profession in the Bryant Building, Kansas City, Mo.

MR. OLIVER N. EILER has resigned as superintendent of the municipal electric light and waterworks plants of Portland, Ind., to accept a position with the S. M. Smith Company, Noblesville, Ind.

MR. H. I. MILLER has resigned his position as general manager of the Vandalia line to accept that of general manager of the Chicago, Rock Island & Pacific Railway Company, with offices at Chicago, Ill.

MR. A. H. BABCOCK has resigned his position as electrical engineer of the North Shore Railroad Company, San Francisco, Cal., and has been appointed electrical engineer of the Southern Pacific Company.

MR. CHARLES J. REED, Philadelphia, Pa., announces that, although he has already received assurances of renomination as secretary of the American Electrochemical Society, it will be impossible for him to serve if elected.

MR. FREDERICK SARGENT, of Chicago, Ill., has been retained as a consulting engineer by the commission in charge of the work of electrically equipping the suburban lines and terminals of the New York Central Railroad in New York city.

MR. W. E. L. GAINE, general manager of the National Telephone Company, of London, and Mr. Frank Gill, chief engineer of the same company, will arrive in New York this week, and intend to visit the telephone interests of the United States.

MR. EMIL O. LUNDIN, president of the Lundin Electric and Machine Company, Boston, Mass., was a visitor to New York city last week. Mr. Lunain announces a brisk trade in the specialties for which his house is well known in the electrical field.

MR. RUSSELL HOWLAND, advertising expert, announces that he has moved to larger quarters at 120 Liberty street, from 150 Nassau street. Mr. Howland is well known in the electrical field, and has a large clientele in this and allied engineering industries.

MR. F. L. WAUKLYN has resigned as vice-president and general manager of the Montreal Street Railway Company and the Montreal Park & Island Railway Company, of Montreal, Quebec. It is reported that he will become vice-president of the Dominion Coal Company and also vice-president of the Mexican Light and Power Company.

MR. GEORGE L. COLGATE, general eastern and export sales agent for the Kuhlman transformer, has the management of a project to utilize current from Niagara Falls, at Batavia, N. Y., for power and lighting purposes. A new street railway company will be one of the first purchasers of power, and it is expected that electric power will also be used to a considerable extent by business interests of the city.

MR. BION J. ARNOLD, president of the American Institute of Electrical Engineers, has met with a serious setback in his plans for a demonstration of his experimental electric pneumatic single-phase railway system. On December 18 a fire in the engine house of the road at Lansing, Mich., destroyed the locomotive, cars and machine shop. The system had been completed and was to have undergone a private test the following morning, to be followed by a public demonstration on January 1. Mr. Arnold will immediately rebuild.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company, has been elected vice-president and director of the Hudson River Telephone Company. Mr. Bethell is rapidly becoming known as the "Pooh-bah" of the telephone operating field. In addition to the above, among other offices held by Mr. Bethell is that of president of the Chesapeake & Potomac Telephone Company, president of the Bell Telephone Company, of Philadelphia, and president of the Atlantic & Delaware Telephone and Telegraph Company.

MR. WILLIAM BARCLAY PARSONS, chief engineer of the Board of Rapid Transit Commissioners of the City of New York, had his left arm fractured while riding on a hand car on December 14 in the tunnel. He was sitting on a front seat rigged up in the car, and threw his arm over the back of the seat. The long-handled bar with which the car was being propelled caught the arm, breaking the bone below the elbow and dislocating the wrist. Mr. Parsons had a narrow escape at the time Major Shaler was killed by a fall of rock in the tunnel.

MR. LaRUE VREDENBURGH, who will present at the twenty-seventh convention of the National Electric Light Association, to be held in Boston, a report on advertising methods for central stations, has sent out a circular to members of the association, asking them to give expressions of opinion as to the methods they have found most effective along this line; what their experience has been as to traceable results from such advertising as they have done, and requesting them to forward him for use in his report samples of advertising matter that, in their opinion, have been the best business bringers. Mr. Vredenburgh will also make a similar request of a large number of foreign central station companies, with a view of comparing methods in this country and abroad, as well as giving the association the benefit of any novel ideas that it would be well to adopt here. The report will have immense practical value for all members wishing to extend their business.

MR. ROBERT T. LOZIER, general manager of sales for the Bullock Electric Manufacturing Company, New York city, announces the following sales organization: Mr. A. F. Wolf, former assistant to the general manager of sales at Cincinnati, has been transferred to the New York office to act as assistant district manager of that office, Mr. E. W. Goldschmidt being the district manager at that point. Mr. W. L. Fairchild, late treasurer of the J. F. Kelly Engineering Company, is now located with the Bullock company and will operate from the New York office. Mr. Halbert P. Hill, formerly with the General Incandescent Arc Light Company and latterly general manager of sales of the Storey company, will take charge of the Bullock exhibit at the St. Louis Exposition, 1904. Mr. Walter B. Spellmire, late district manager of the Atlanta office, has accepted the vice-presidency of the A. W. Wyckoff company, with headquarters at Pittsburg, Pa.; the Wyckoff company taking the place of the Pittsburg Engineering Company in representing Bullock interests in that section. Mr. G. C. Henry, formerly general manager of the Florida Electric Company, has been appointed district manager at Atlanta. These increases in the sales forces are brought about to meet the very largely increased demand there is for Bullock apparatus.

MR. S. MARSH YOUNG, manager of the electric railway department of the Pneumatic Signal Company, New York, tendered a trip to Rochester, N. Y., to a party of prominent signal engineers and railway men on Friday, December 18. The party inspected the Young automatic block signal system, which has been installed on the Rochester & Sodus Bay road at Float Bridge. In the party were C. W. Hotchkiss, president of the Indian Harbor Railroad Company; Azel Ames, signal engineer, Boston & Albany Railroad; J. C. Irwin, New York Central & Hudson River Railroad; Charles A. Barnes, engineer, New York State Railroad Commissioner; Professor Fitzhugh Townsend, Columbia University; D. F. Carver, chief engineer, Public Service Corporation; R. E. Danforth, general manager, Rochester Railway Company; J. M. Waldron, signal engineer, Interborough Rapid Transit Company; R. G. Siegel, signal engineer, Brooklyn Rapid Transit Company; J. N. Beckley, president, Charles Hansel, vice-president and general manager, John T. Cade, sales manager, F. L. Dodgson, chief engineer, and Arthur Dean, signal engineer, of the Pneumatic Signal Company. The party was entertained very hospitably, and was conveyed to and from the several points of inspection in a special car provided by Mr. Young.

LEGAL NOTE.

IMPORTANT DECISION INVOLVING TELEPHONE SWITCHBOARDS—In the suit on the Scribner patents, Nos. 357,538 and 552,729, and the Scribner and Warner patent, No. 488,033, covering long and short springs in spring jacks, a decision was handed down on December 22 in the United States Circuit Court, Northern District of Ohio, by Judge Francis J. Wing, in favor of the North Electric Company. This suit was contested by the Western Electric Company. The opinion in full reads: "In this cause the bill is dismissed, and judgment for costs is awarded against the complainant." Barton & Tanner were the attorneys for the complainant, and Lawrence for the defendant. An adverse decision would have been a very severe blow to independent telephone interests.

ELECTRIC RAILWAYS.

MARSHALLTOWN, IOWA—The Iowa City, Davenport & Muscatine Interurban Railway Company is surveying a line from Davenport to this city.

NOBLESVILLE, IND.—The city council has granted Wallace B. Campbell, of Anderson, a franchise for fifty years to operate an interurban line through this city, connecting Anderson and Lebanon.

WASHINGTON, PA.—The Washington & Canonsburg Railway Company will build a line across the country from Washington to Finleyville, and will commence work on the same within a period of three months.

GREELEY, COL.—George J. Spear has been granted a franchise by the city council. It is to run for fifty years, and provides that at the end of thirty years the city shall receive $250 a year for each mile of trackage for the use of the streets.

BENTON HARBOR, MICH.—It is reported that the right of way for the proposed line of the Kalamazoo & Lake Michigan Electric Railway between this place and Kalamazoo has been secured, and it is now expected to have the road in operation by July next.

MEMPHIS, TENN.—An amendment to its articles of incorporation has been filed by the Fort Smith Suburban, increasing its capital stock to $100,000. The promoters intend to extend the line so as to make connection with the St. Louis, Iron Mountain & Southern Railroad.

JOPLIN, MO.—The Southwest Missouri Electric Railway has purchased the Mineral Cities Electric Line, which is partially constructed, between Joplin and Pittsburg, Kan. This will give the Southwest Missouri a through line from Carthage to Pittsburg, a distance of forty-five miles.

BAY CITY, MICH.—Advices from Detroit state that traffic arrangements have been completed whereby the line now being built from Flint to Saginaw will run to Bay City over the tracks of the Bay City-Saginaw United Traction Company, through service to be given from Bay City to Flint.

CHARLOTTESVILLE, VA.—The Charlottesville City & Suburban Street Railways Company's holdings in the city and suburbs have been sold at public auction for $50,000 to the bondholders, represented by a committee of three—R. H. Wood, C. J. Rixey and Lewis T. Nackel. The amount paid is equivalent to from $95,000 to $100,000.

ASHTABULA, OHIO—An electric railway is projected from Warren, Ohio, to Jefferson, Ashtabula County, where it will connect with three Pennsylvania and Ohio lines for Ashtabula. It would pass through Cortland, Mecca, Greene, Colebrook, New Lyme and Lenox. At Kennelworth it would cross the Middlefield-Sharon division of the Cleveland & Eastern.

WHEELING, W. VA.—The Wheeling & Elm Grove Railway Company has opened its line to West Alexander, a distance of eighteen miles. The company's next step will be the extension of its lines on through to Claysville and later to Washington, Pa., when a connection with another interurban line will give this city through traction service to Pittsburg.

READING, PA.—In order to increase the service from the Klapperthal station of the Metropolitan Electric Company, a heavy copper feed wire is being strung from this city. The distance is three and one-half miles, and the weight of the cable about 35,000 pounds. When the work is completed the company expects to increase the service for railroad purposes about one-third.

SAN JOSE, CAL.—Articles incorporating the Palo Alto & Suburban Railway Company have been filed in the county clerk's office. It is capitalized at $100,000, its principal place of business is to be in Palo Alto, and its existence is placed at fifty years. The directors of the company are John F. Parkinson, G. F. Gray, K. H. List, W. P. Gray, L. N. Hobbs, G. S. Parkinson, W. E. Crossman.

QUINCY, ILL.—The survey for the proposed electric line between Palmyra and Philadelphia. Very little of the line follows The entire distance is twenty-one and one-half miles—ten and one-quarter between Hannibal and Palmyra, and eleven and one-quarter between Palmyra and Philadelphia. Very little of the line follows the county roads, but cuts directly across the country, and in most cases the grade is very slight.

GOSHEN, IND.—Local capitalists have effected a temporary organization for the formation of a company to build an electric line from Goshen to Warsaw, to make a connecting link between the trunk lines of the Indiana Union Traction Company and the Indiana Railway Company. The officers are: president, F. E. C. Hawkes; vice-president, Haines Egbert; secretary, B. F. Deahl; treasurer, F. G. Hubbell.

RICHMOND, IND.—The Wayne County commissioners have granted a franchise to the Columbus, Greensburg & Richmond Traction Company. The franchise is for the townships of Center, Abington, Washington and Wayne. The franchise only grants the right to cross the roads wherever necessary. The company has its own right of way. The franchise states that the line is to be built within two years.

MINNEAPOLIS, MINN.—The Minnesota Power and Trolley Company has filed articles of incorporation with the secretary of state. The company is capitalized at $500,000, and it purposes, according to the articles of incorporation, to develop water powers and construct electric railways. The incorporators are Charles O. Straub, Joseph L. Kichli and Mathias Schuienberg, all of Minneapolis, and Charles Swanson, of Fridley, Anoka County.

CARLISLE, PA.—Preliminary to the construction of a trolley line from Harrisburg to this place, a charter has been granted by the State Department to the Camp Hill Turnpike Company, of Cumberland County. This company is to construct a turnpike from the Susquehanna at Bridgeport for a distance of three and one-half miles. The incorporators are L. A. Sweigard, of Atlantic City; John A. Cox, of Gettysburg, and S. J. Harris, of Carlisle.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company has doubled its service between Kokomo and Greentown. Cars now run every half hour, instead of every hour. The company let a contract with a Philadelphia electrical house for the equipment of a new power station in Kokomo. The machinery will cost $250,000, and the buildings and power plant complete will cost $400,000. Work on the line is progressing eastward, and cars will be running to Marion before many weeks.

JOPLIN, MO.—Articles of incorporation have been filed for the Joplin, Neosho & Pierce City Interurban Railroad Company. The company's offices will be in Neosho, and it intends to operate in the counties of Jasper, Newton, Barry and Lawrence, touching the towns of Joplin, Sarcoxie, Pierce City, Stotts City, Newtonia, Granby and Neosho. The capital is fixed at $50,000 and there are five directors, as follows: Charles Cunliff, William S. Brawner, John Kimpel, John Weathers and Benjamin Cunliff.

FREDERICK, MD.—At the annual meeting of stockholders of the Myersville & Catoctin Electric Railway Company, held at Myersville, the following directors were elected: Christian W. Lynch, J. Clarence Lane, William Jennings, John M. Lane, W. C. Hepperle, H. H. Keedy, of Hagerstown, and Cyrus F. Flook, John C. Leatherman, Herman H. Routzahn and George D. Gover, of Myersville. The board organized by electing Christian W. Lynch, president; J. Clarence Lane, vice-president; John M. Lane, secretary, and William Jennings, treasurer.

INDIANAPOLIS, IND.—The Dayton & Western Traction Company, capitalized at $10,000, has been formed for the purpose of constructing a traction line from Richmond east to the Ohio state line, to connect with the Ohio portion of the company's line. Henry C. Starr and John F. Robbins, of Richmond, are the Indiana capitalists interested in the scheme. The other incorporators are Valentine Winters, Howard Fravel, Frederick Funkhouser and Albert S. Weusthoff, all of Dayton, Ohio, and Richard W. Deaver, of West Alexandria, Ohio. The line will connect with the tracks of the Indianapolis & Eastern Traction Company in Richmond.

PENN YAN, PA.—The amended incorporation papers of the Lake Keuka & East Side Electric Railroad Company recently filed with the county clerk show that the capital stock will be $130,000. The directors for the first year are: James T. Harris, Joseph C. Harris and Charles H. Hanscomb, of New York; Morris F. Sheppard, William H. Fox and Charles H. Sisson, of Penn Yan; David H. Hoover, of Keuka Landing; Frederick Crosby, of Crosby's Landing, and J. Monroe Shoemaker, of Elmira. The road will run from this village along the eastern shore of lake Keuka to Keuka Landing, twelve miles from Penn Yan, and eventually it will be extended to Hammondsport.

INDUSTRIAL ITEMS.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., will be glad to answer enquiries addressed to its transformer department, regarding "Salus" compound, the new insulation for Packard transformers.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin No. 80 describes the installation of chloride accumulators for the Ottawa Electric Railway Company. This bulletin will be sent upon request.

MESSRS. BRAMWELL & HARRIS, 5 Great George street, Westminster, England, announce, in referring to the recent loss which the company sustained in the death of Sir Frederick Bramwell, that the business of Bramwell & Harris will be carried on as heretofore at the above address, and that the offices at Edinburgh and Cardiff will be continued and the name of the firm remain unchanged.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports an exceedingly lively interest in its push-button switches. The company has important installations of these switches specified in nearly all of the large cities of the country, and by some of the most prominent architects and electrical engineers. The uniform plates and universal adaptation to all forms of conduit boxes are greatly appreciated by the contractors' trade, as their work is thereby simplified.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, will be pleased to send its new price list "C," applying to catalogue No. 14. This price list takes effect December 14, 1903, and supersedes all previous quotations. This list gives the quotations on every conceivable character of electrical apparatus. A new design of an electrical portable which this company is marketing is a lamp nineteen inches to top of shade, finished in combination brush brass and black.

THE CARLETON-CHASE ELECTRIC COMPANY, New York city, is placing on the market a universal adjuster for suspended electric lamps, which is designated as the "Electrogrip." This is a device for attaching to the socket of an incandescent lamp, and is so constructed that it adjusts the lamp to any position desired. The device may be used with any size of cable, and is not only used as an adjuster, but also as a take-up, and, the manufacturer states, will not in any way wear the insulation off the cord.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has published a souvenir bulletin descriptive of magneto telephones. This is one of the handsomest pieces of telephone literature which any company has had the good fortune to produce. The typography and illustrations are excellent, and the cover is artistic to a high degree. The information given in this bulletin is valuable and may be looked up with profit by not only the prospective exchange operator, but by the telephone engineer as well.

THE ROTARY ENGINE COMPANY, 135 South Second street, Philadelphia, Pa., will be pleased to send its bulletin No. 1 to interested parties. This describes and illustrates the direct-connected generating sets for power and lighting, running from 12½ to 130 kilowatts. This bulletin presents a concise description of the Warren rotary engine, the principles involved in which have been developed and tried through several years of study and a long series of practical experiments. The manufacturer states that as a prime mover the Warren engine possesses every desired qualification and represents an extreme of simplicity of construction and perfect mechanical action.

THE MISSOURI-AMERICAN ELECTRIC COMPANY, St. Louis, Mo., reports a rapidly increasing business, for which it has extended the capacity of its plant. This is a new plant, and the building has a total floor space of about 20,000 square feet. The plant is equipped with a large number of labor-saving devices, some of which have been invented and patented by Mr. McDonnell, vice-president and general manager of the company. In addition to the manufacture of lamps, this company intends placing on the market very soon a new current controller, a new lighting device and a new sign flasher. Mr. A. W. W. Miller is president of the company and Mr. George P. McDonnell is vice-president and general manager.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., in a handy booklet describes the general line of machinery which it manufactures. This company has had thirty years' experience, and has one of the largest and best-equipped shops in America for this line of manufacture. The company designs and builds every article in its own works, and fully guarantees the material and workmanship. Among the more important machines described in this booklet are steeple towers, parabolic boom towers, steam shovels, elevators, overhead trolleys, coal tubs, automatic railways, cable railways, steam and electric hoisting engines, blocks and sheaves, coal crackers, conveyors, coal screens and valves, industrial railways and electric locomotives.

THE LAIDLAW-DUNN-GORDON COMPANY, 114 Liberty street, New York city, has recently issued bulletin L 509, describing a new line of air compressors. These compressors are fitted with Meyer steam valve gears, permitting of an adjustable cutoff. The air ends are arranged both with poppet inlet and outlet valves and with mechanically operated inlet and poppet outlet valves, the valves in either case being placed in the head of the cylinder, permitting the body to be effectively water-jacketed. The frames of these compressors are especially heavy. The capacities listed range from 463 to 2,220 cubic feet of free air per minute, and the air pressure from 80 to 100 pounds per square inch. This pamphlet will be sent upon request to those interested.

THE DIELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will be pleased to send its catalogue on insulating materials to any one interested in this subject. The aim of the Dielectric Manufacturing Company has been to reach the closest practical approximation to an ideal insulation, by a careful study and manipulation of the raw materials, supplemented by a careful study of the mechanical, chemical and electrical requirements of the different parts of electrical apparatus which require to be insulated from one another. "Dielectrol" is a black fluid of varnish consistency, and is intended for either dipping finished coils or for painting on coils as they are being wound. It dries in air, but the company recommends baking, for the double reason of driving out all moisture from the cotton covering and allowing the excess of material to drain off. The company will be pleased to furnish samples of this material on request.

ROSSITER, MACGOVERN & COMPANY, 17 Battery place, New York city, in their December bulletin, call attention to an extensive line of electrical and steam machinery. The apparatus described in this bulletin is guaranteed to be first-class in every particular, and the dealers state will be found to be most modern in type and of the best known manufacture. With few exceptions, this company is in a position to make immediate deliveries, and the material can be inspected at any of its factories, either in Jersey City, N. J., or in St. Louis, Mo. The machinery which this firm handles is invariably overhauled or thoroughly looked over and tested before shipment, so that the company has no hesitancy in giving the same guarantees as are furnished by the leading manufacturers. In addition to dealing in electrical and steam machinery, Rossiter, MacGovern & Company maintain in both Jersey City and St. Louis extensive repair shops, where they are prepared to execute promptly any kind of electrical repair work.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., in bulletin No. 8 describes its line of non-multiple central energy switchboards. In publishing this switchboard bulletin the company has endeavored to show illustrations and drawings of the various styles of cabinets which it manufactures for non-multiple central energy systems. Especial attention is called to the matter of equipment and the method of specifying this. In connection with the illustration of each switchboard a number of standard equipments are given and designated, as Standard Equipment "A," "B," etc. These cabinets and equipments are regularly carried in stock, and the orders for these are not subject to delay, whereas special equipments are subject to more or less delay, depending upon the amount of work necessary to provide for the special orders. In addition to the strictly commercial descriptive matter, there is a lot of valuable information which has been compiled for the benefit of purchasers of this class of apparatus. This information will prove of great value to parties operating small magneto or generator-call systems, or who are thinking of equipping their plants with a central energy system.

I. X. L.

WEATHER-PROOF WIRE

IT WILL NOT CRACK WHEN COLD

IT WILL NOT SOFTEN WHEN HOT

SAMPLES SENT ON REQUEST

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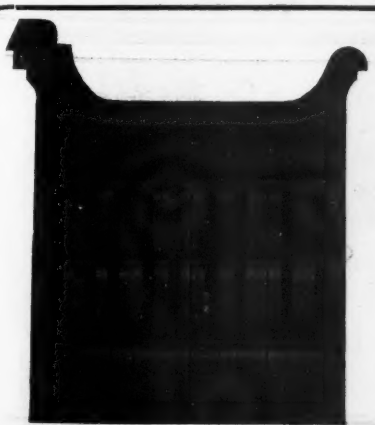

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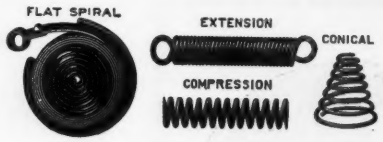

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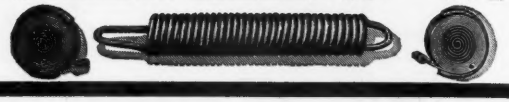

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STANLEY RECORDING WATTMETERS.

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NO REVENUE LOST.
ALL CURRENT USED RECORDED.

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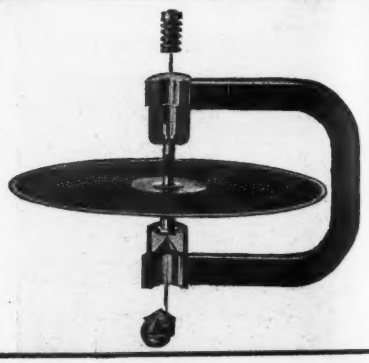
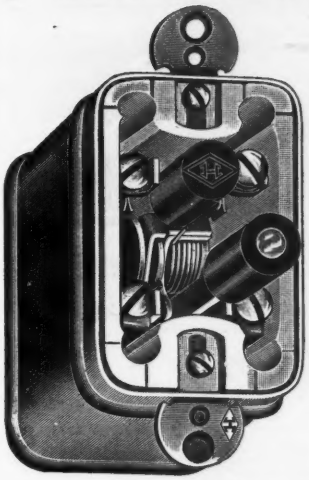
FOR MEXICO—VICTOR M. BRASCHI & BRO., Mexico City



DIAMOND H PUSH SWITCHES



are also designed in self-contained wall case. This type will be found satisfactory for use in old walls and in woodwork, and in all cases where a suitable receptacle for switches was not provided in the building construction. These cases are made of cold rolled steel, galvanized, and openings are in bottoms for entrance of wires or flexible conduits.

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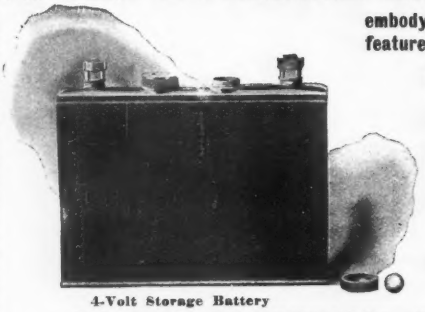

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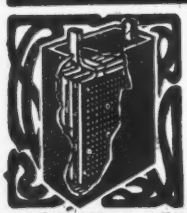

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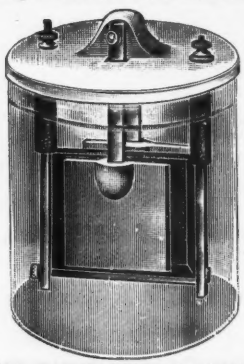

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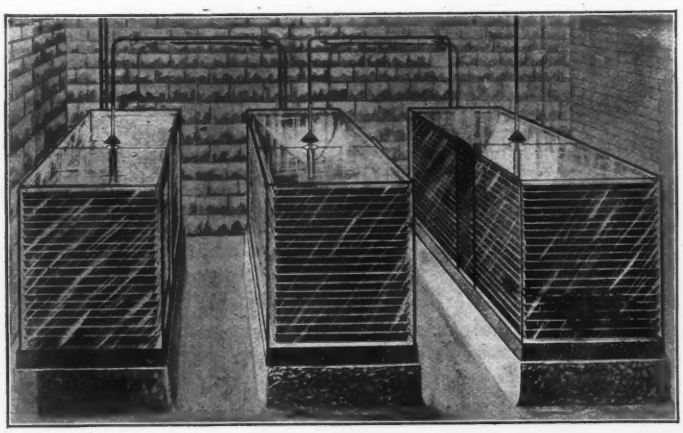

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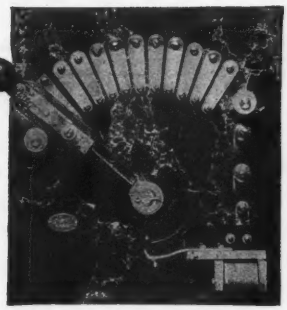

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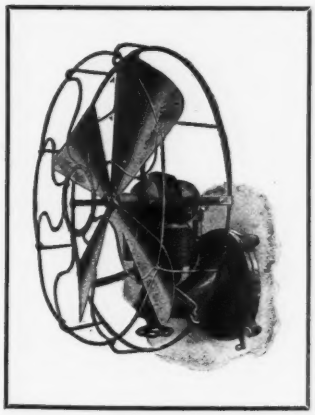

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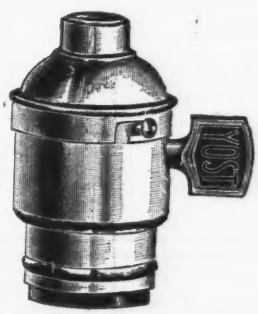

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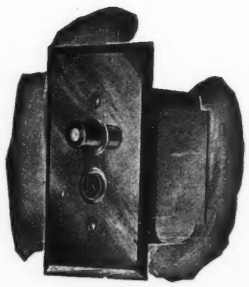

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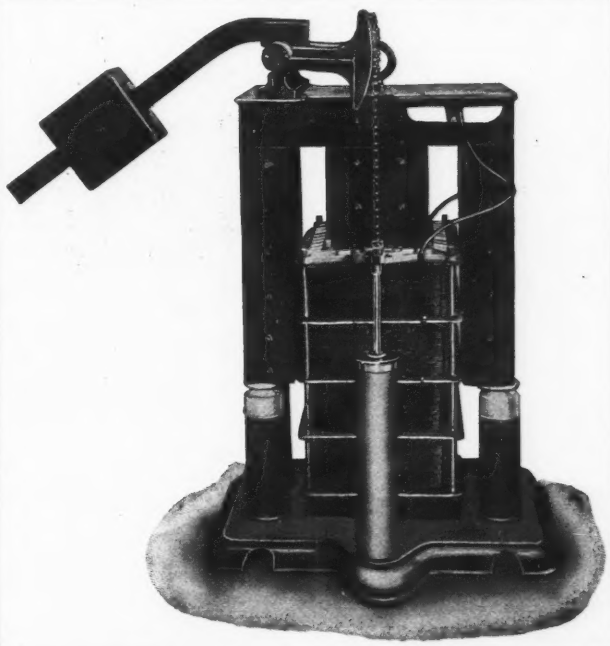

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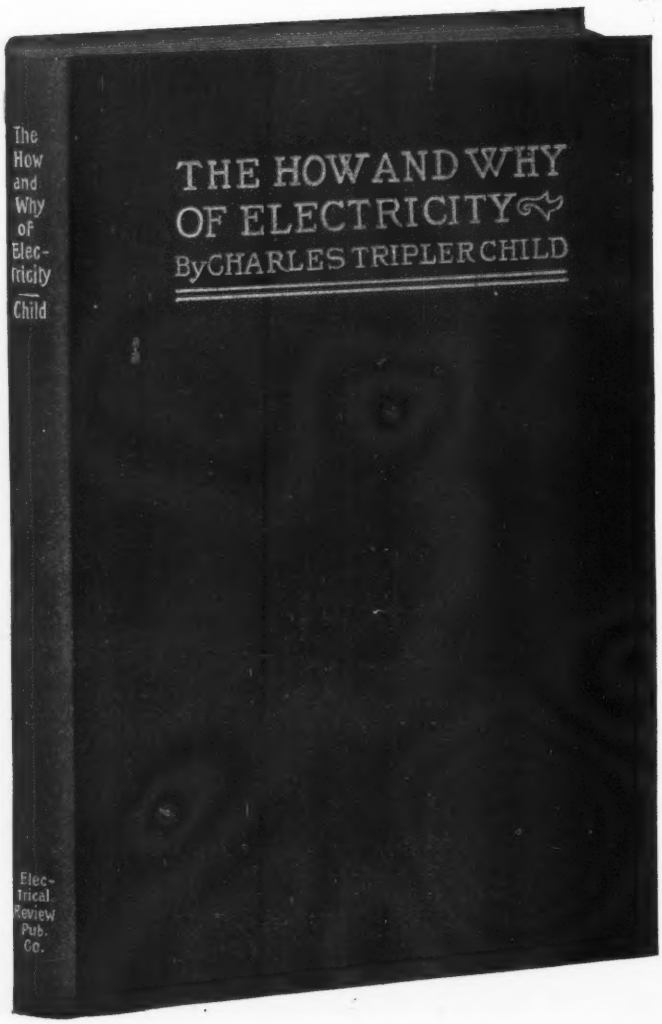

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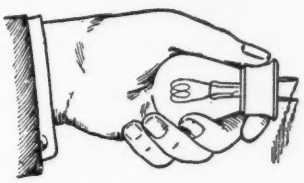

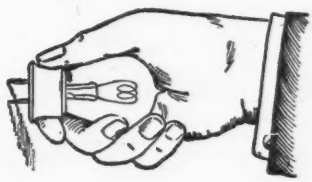

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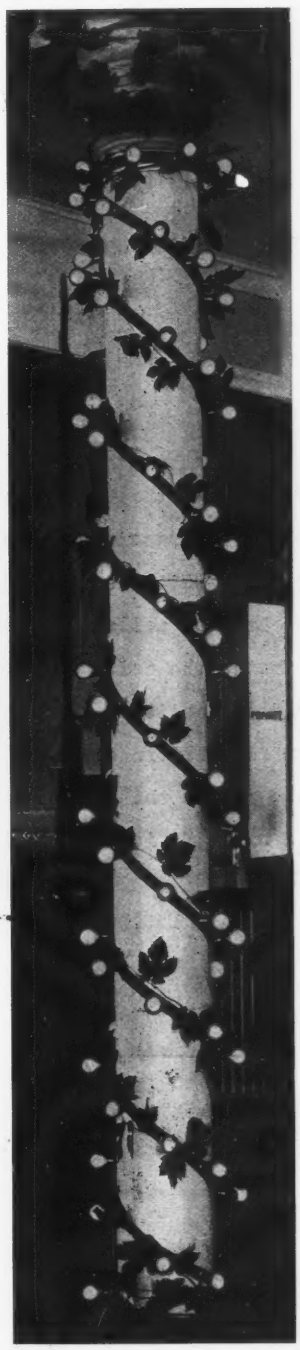

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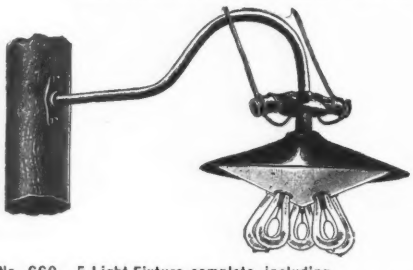

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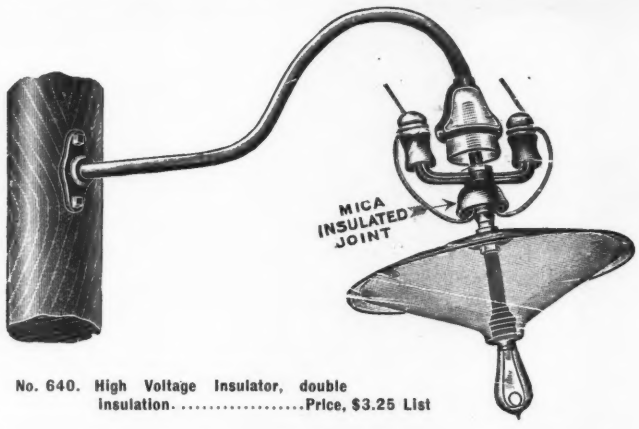

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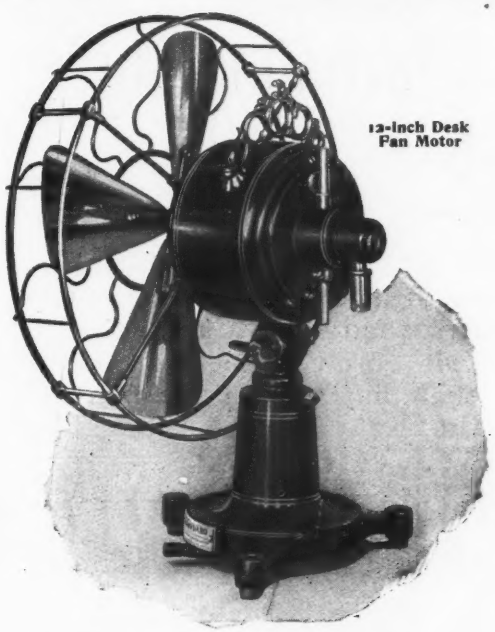

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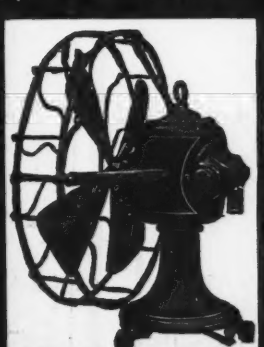

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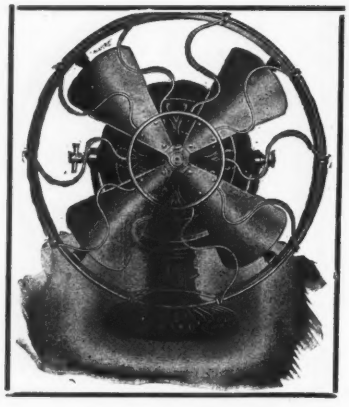

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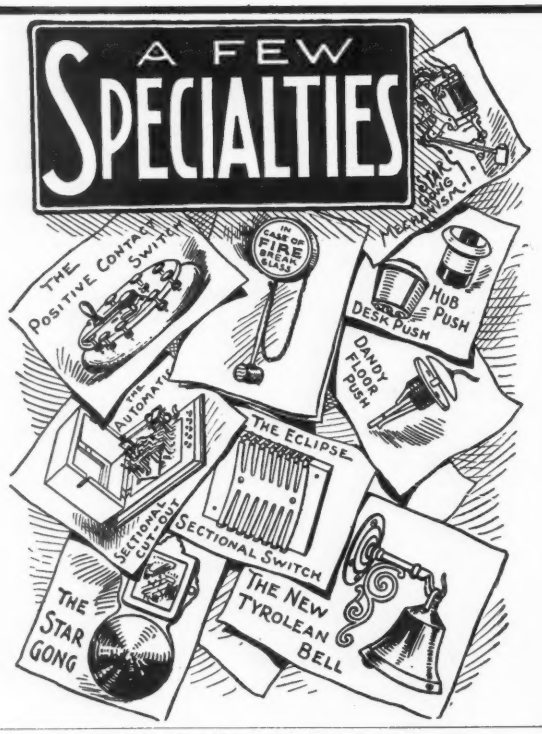

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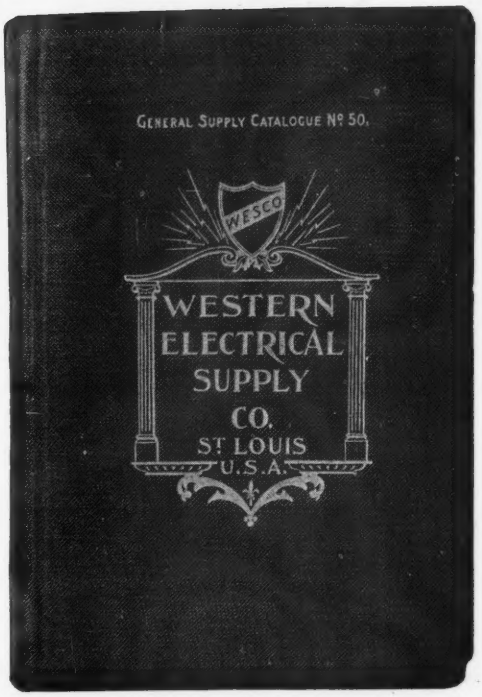

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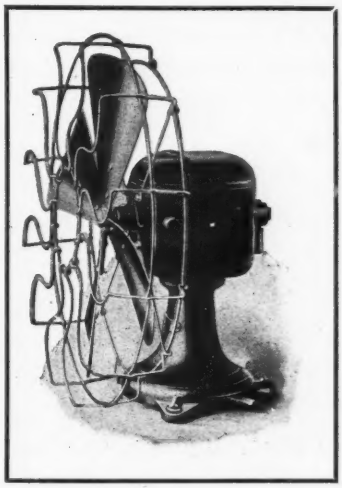

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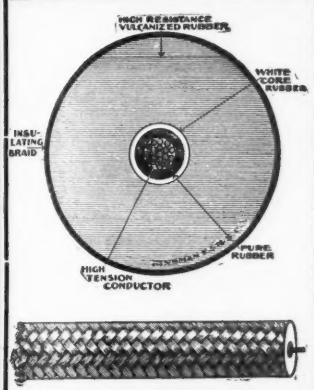

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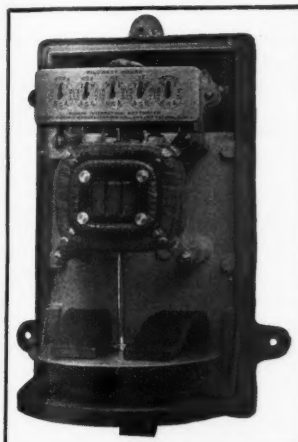

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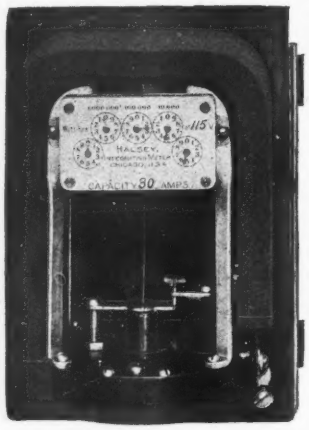

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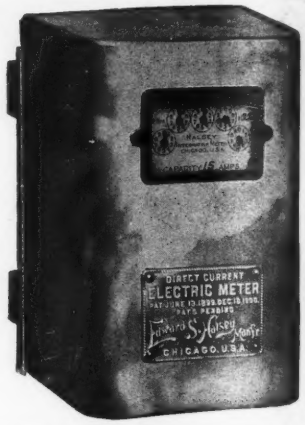

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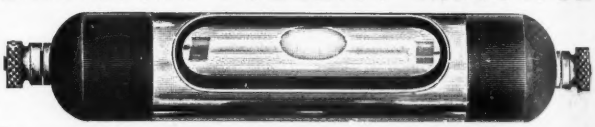

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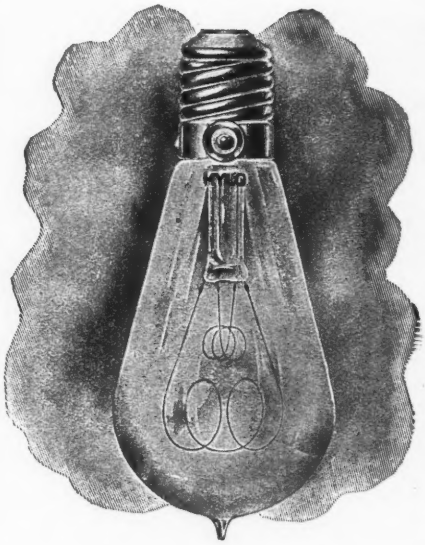

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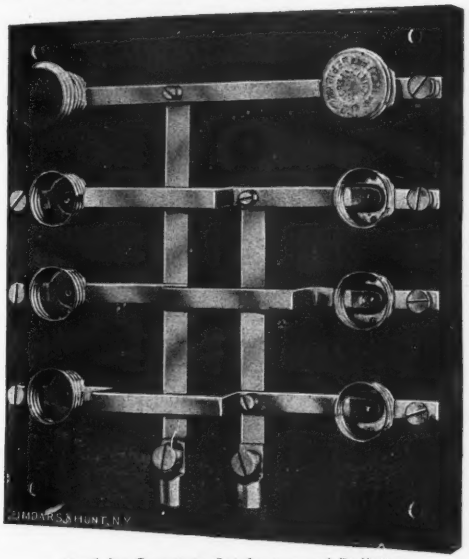

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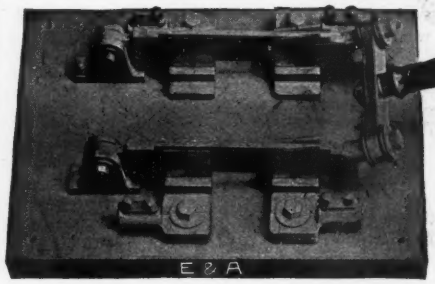

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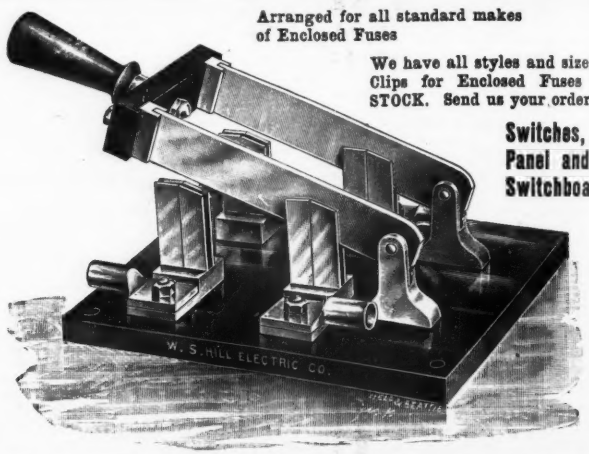

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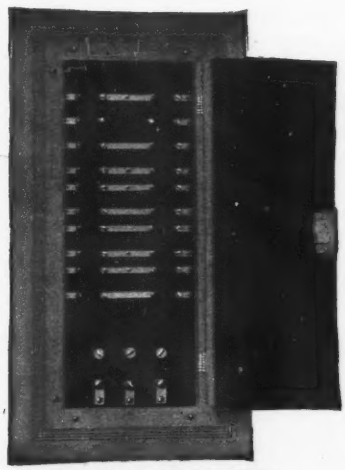
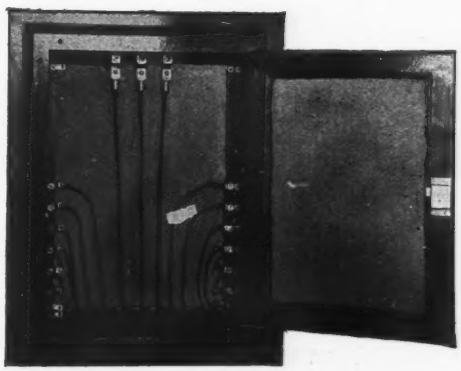


STYLE E 32 F PANEL
Ten circuit panel with main fuses in flush wood box with quartered oak trim



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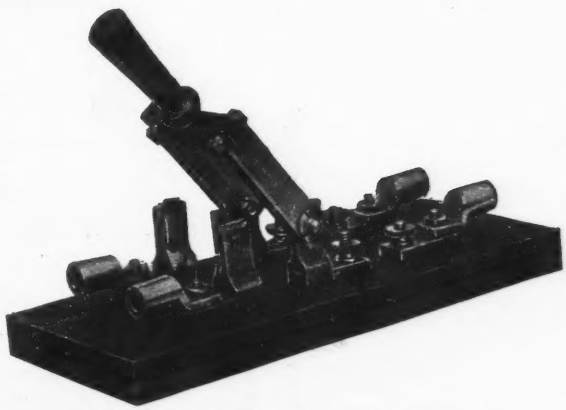

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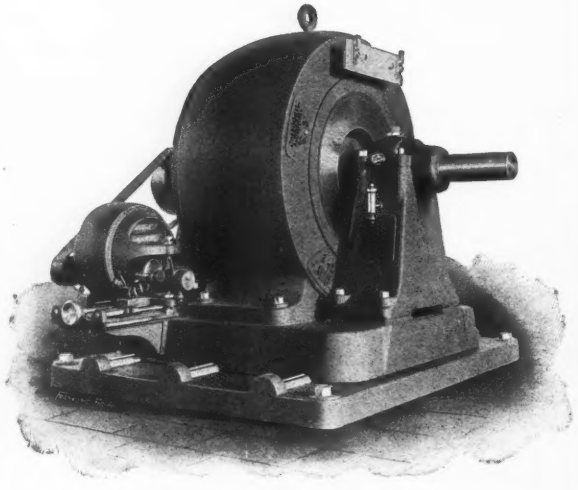

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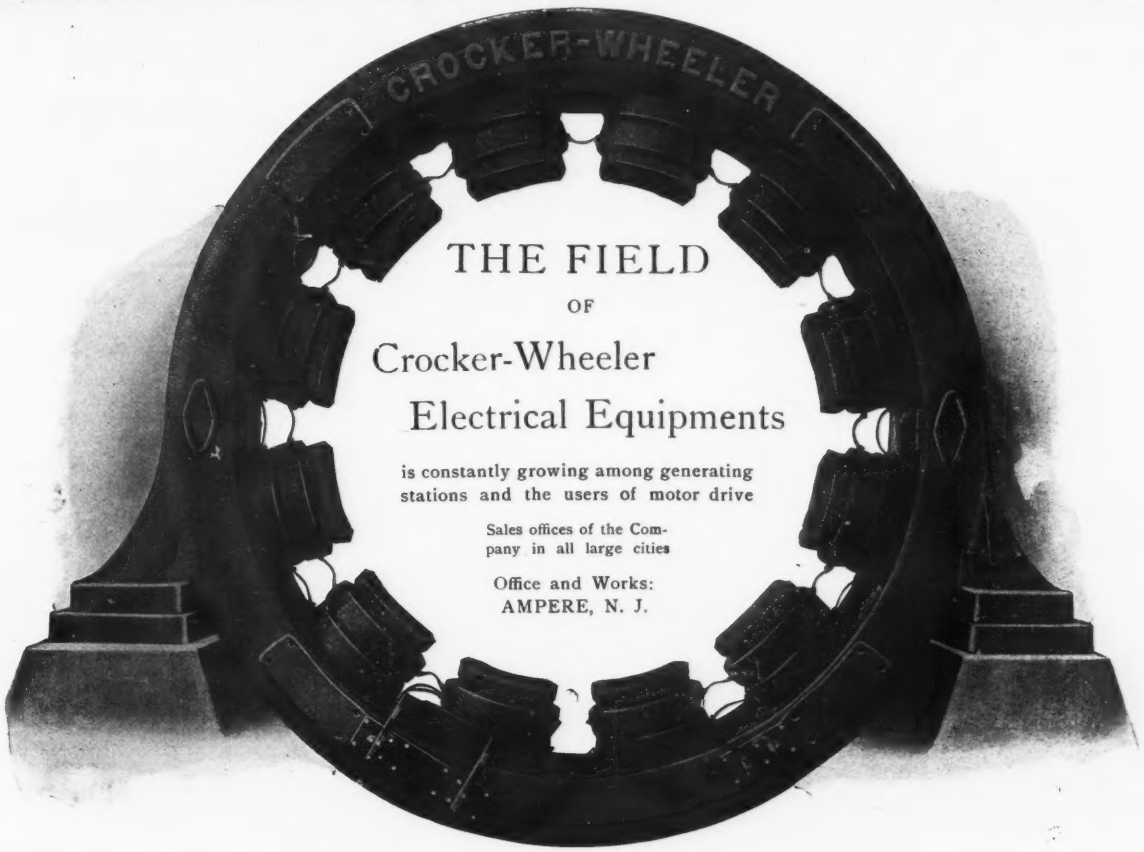

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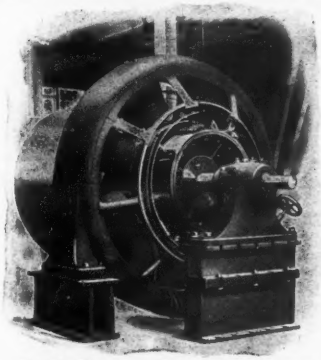

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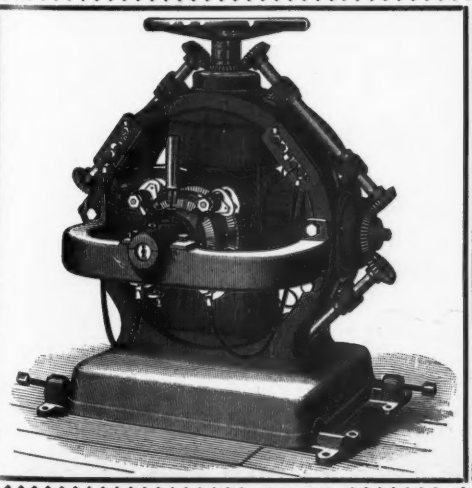

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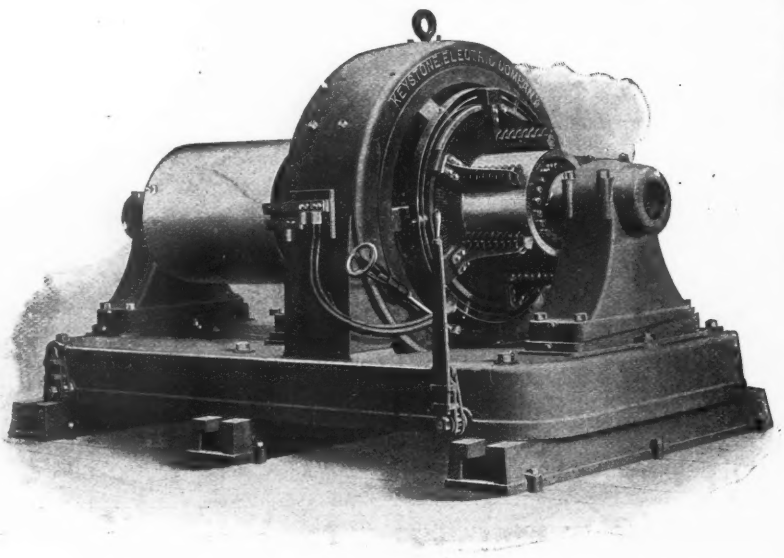

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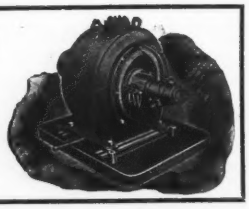

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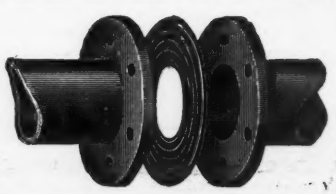

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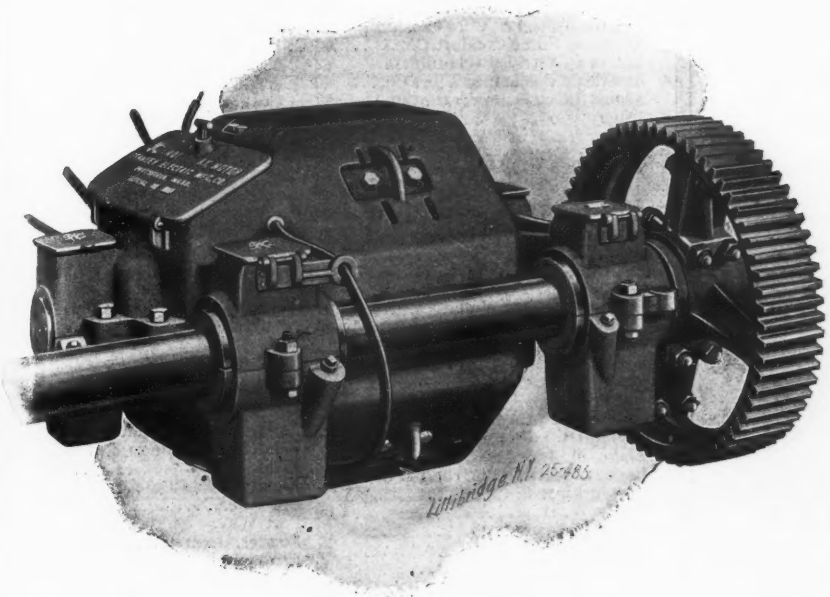

The **Frame** is divided horizontally into halves. The lower half can readily be swung down to the position shown in the illustration, or, if desired, it may be entirely removed.

The **Pole Pieces** are made up of soft laminated steel punchings riveted together. Each pole piece has a flare at the armature end which, besides holding the field coil in place, effects the best distribution of the magnetic flux.

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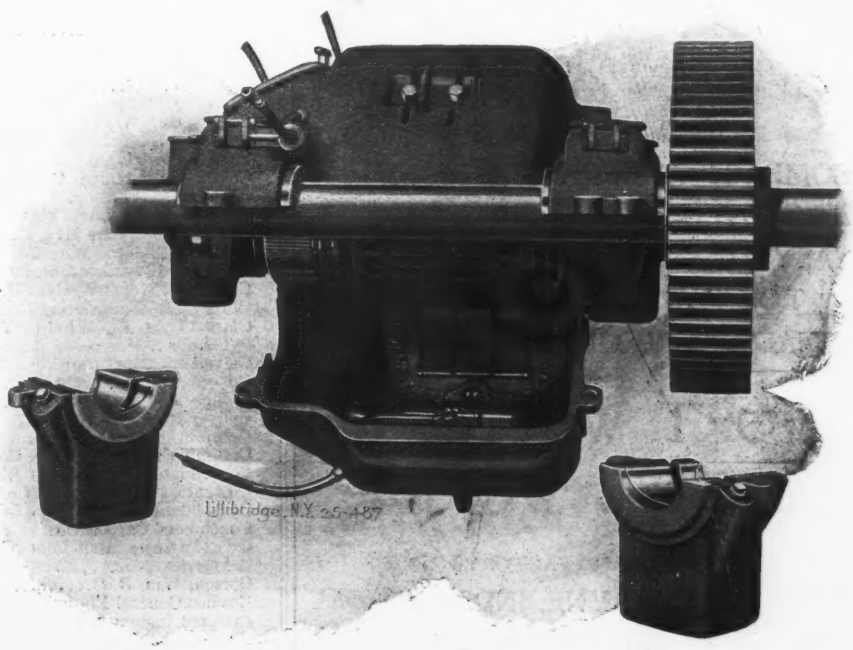
The **Field Coils** are wound of square wire. After the usual insulation, the coils are wrapped in layers of rope-paper, mica and tape, with leatheroid protection, where there is liability of chafing. The terminals of each coil are brought out through holes in the frame and are attached to the car wiring on the outside. This is a feature which repair men will appreciate.

The **Armature** is unusually well ventilated. Large ducts parallel to the shaft allow the air to enter the body of the armature and ventilating ducts, perpendicular to the shaft, allow the heat to escape. The end castings project above the level of the coils so as to protect the end winding from injury. The armature coils are form-wound, dipped and thoroughly insulated with oiled linen and tape. The band wires holding the coils in place lie in grooves below the general surface of the armature thereby protecting them from injury.

A neat **Cover Over the Commutator** permits inspection of same and replacing of brushes. Another hand-hole allows inspection from below.

Bulletin 130 gives further details of S. K. C. Railway Motors.



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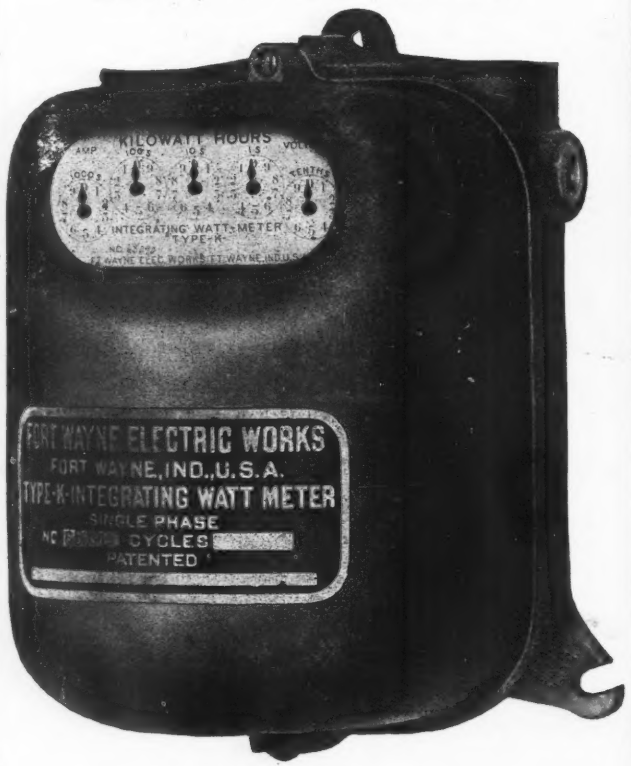

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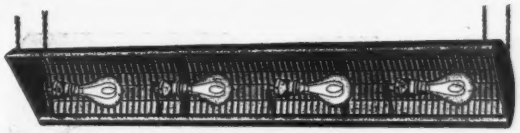

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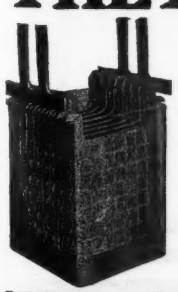

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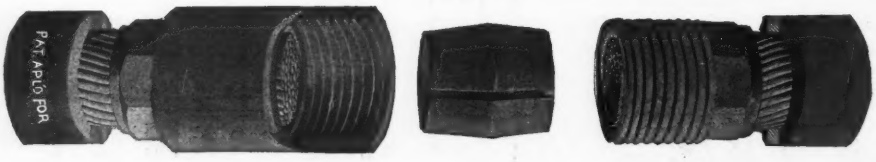

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W. J. Murphy Gen. Mgr.

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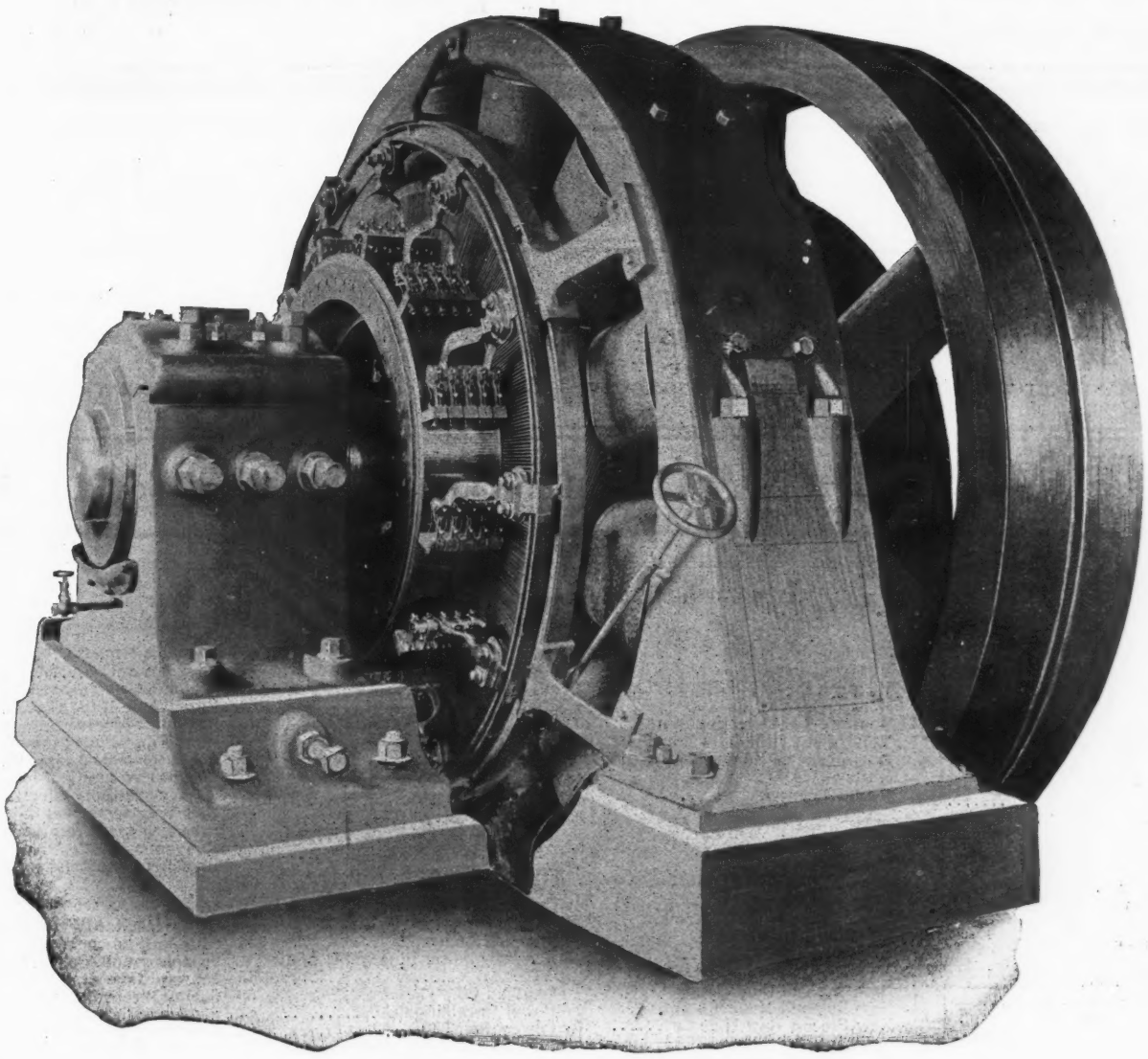

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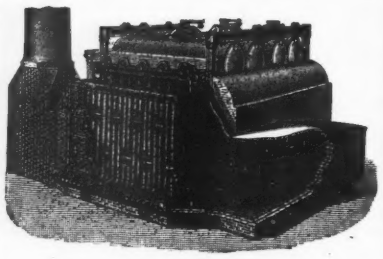

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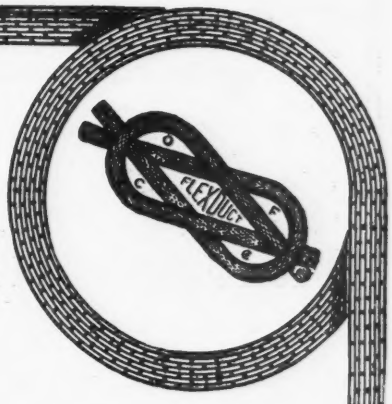

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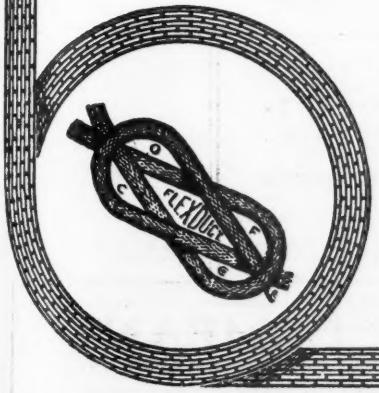

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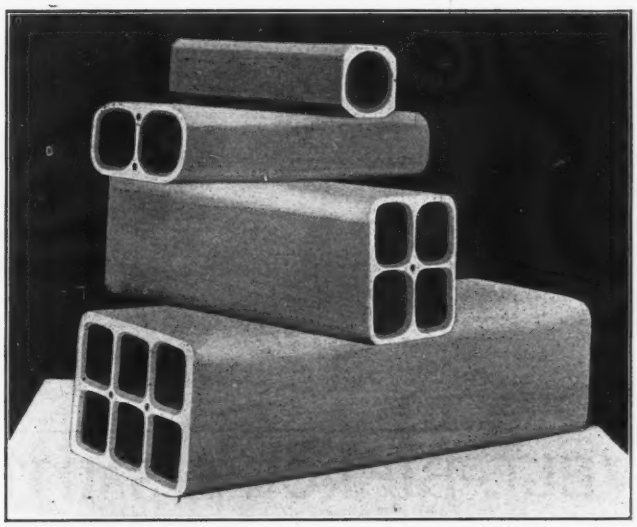

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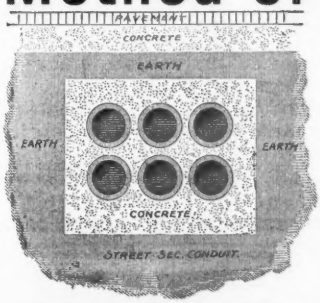

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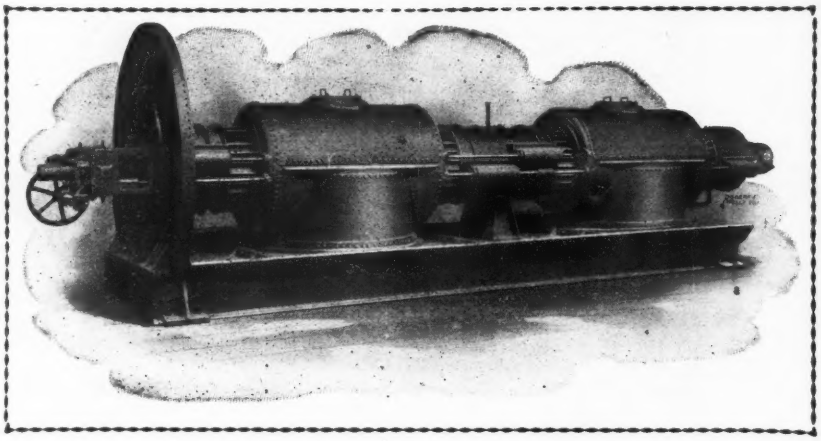

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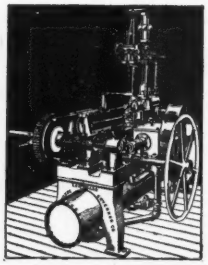

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Attempts have been made to replace the threaded or pipe-coupling rods with others, which could be more easily and quickly connected, but defects were found in each case, which prevented their coming into practical use.

In using rods with joints that were easily detached heretofore, a loose joint was found, which caused the rods to buckle and form a zigzag line when they were pushed through the ducts, thus destroying the alignment, and, in consequence of the friction caused by the ends of the rods being forced against the sides of the ducts it was necessary ofttimes to employ the combined strength of several men to manipulate the rods. All of these disadvantages have been eliminated in the Villard Frictionless Wheeled Rods, which have a more secure and quickly applied coupling than any heretofore produced. The rods are very light running owing to their being provided with wheels.

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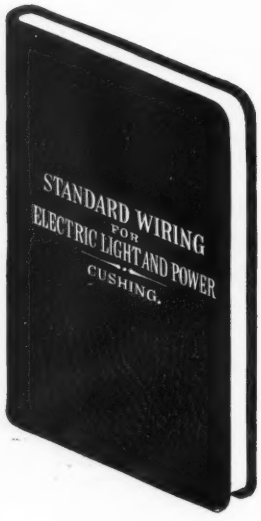

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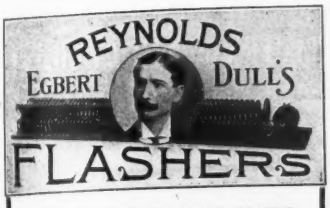

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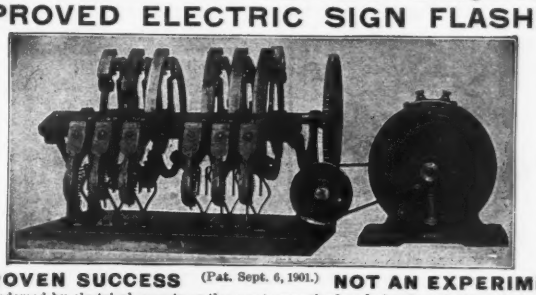

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The Jeffrey Mfg. Co.

Commutator Lubricant.
Allen & Co., L. B.
Hart & Co.

Commutator Segments.
Billings & Spencer Co.

Condensers (Electric).
Marshall, Wm.

Conduits.
Alphaduct Mfg. Co.
American Circular Loom Co.
American Conduit Co.
American Stone Conduit Co.
American Vitrified Conduit Co.
Camp Co., H. B.

Conduits.
Field, C. J.
Gest, G. M.
National Conduit & Cable Co.
Osburn Flexible Conduit Co.
Pittsburg Sewer Pipe & Conduit Co.
Rittenhouse-Miller Co.
Sprague Electric Co.
Standard Vitrified Conduit Co.
Wyckoff Pipe & Creosoting Co.

Conduit Benders.
Benson & Co., Wm. W.

Connectors
Smith & Hemenway Co.

Connectors and Terminals.
McIntire Co., The C.

Construction.
J. G. White & Co.
New England Engineering Co

Construction Supplies.
T. H. Brady.

Cross-Arms, Brackets, Pins, Ties, Climbers, Etc.
Central Electric Co.
Donnelly, John.
Eccleston Lumber Co.
Fowler, John H.
Hopkins & Co., A. P.
Klein & Son, Mathias.
Standard Pole & Tie Co.
Valentine-Clark Co.
Wyckoff Pipe & Creosoting Co.

Dynamos and Motors.
Browning Mfg. Co.
Bullock Electric Mfg. Co.
Central Electric Co.
Coho & Co., H. B.
Christensen Engineering Co.
Cleveland Armature Works.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Eck Dynamo & Motor Works.
Elwell-Parker Electric Co.
Fort Wayne Electric Works.
General Electric Co.
Gen'l Incandescent Arc Light Co.
Hobart Electric Mfg. Co.
Johnson, Charles F.
Keystone Electric Co.
National Electric Co.
New England Motor Co.
Robbins & Myers Co.
Rossiter, MacGovern & Co.
Sprague Electric Co.
Stanley Electric Mfg. Co.
Stow Manufacturing Co.
Thresher Electric Co.
Toomey, Frank.
Van Loan Co., I. S.
Wagner Electric Mfg. Co.
Warren Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Lighters.
Electric Contract Co.
Stanley & Patterson.

Electric Locomotives.
General Electric Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Bossert Electric Construction Co.
Bullock Electric Mfg. Co.
Bunnell & Co., J. H.
Ericsson Telephone Co.
Fort Wayne Electric Works.
Gen'l Incandescent Arc Light Co.
Johnson & Morton.
Lamp Testing Bureau.
Leeds & Northrup Co.
Machado & Roller.
Pignolet, Louis M.
Wagner Electric Mfg. Co.

Electric Soldering Irons.
American Electrical Heater Co.
Simplex Electrical Co.

Electrical Supplies.
Central Electric Co.
Electric Appliance Co.
Ericsson Telephone Co.
Ewing-Merkle Electric Co.
Johnson & Morton.
Jones & Son, J.
Kinsman Electric & Railway Sup. Co.
Lawrence-Hall Electric Co.
Manhattan Electrical Supply Co.
Marshall-Sanders Co.

(*Continued on page 67*)

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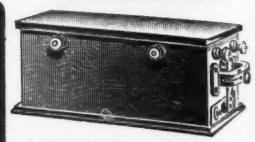

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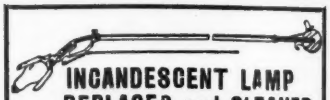

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HANDLES THEM AT ANY HEIGHT OR ANGLE
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why Bullock Dynamos and Motors are specified by the better class of engineers is because they are built according to the recommendations of the Committee on Standardization appointed by the American Institute of Electrical Engineers. Send for our descriptive bulletins.

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IS A TIME SAVER
A GREAT CONVENIENCE FOR
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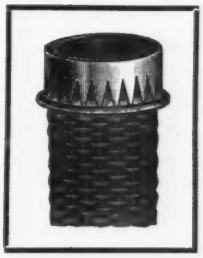

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Pull the Conduit through outlet, then force the little brass collar over the end. The sharp teeth will readily engage the fabric and hold the Conduit firmly in its place.

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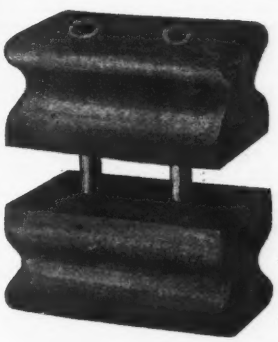

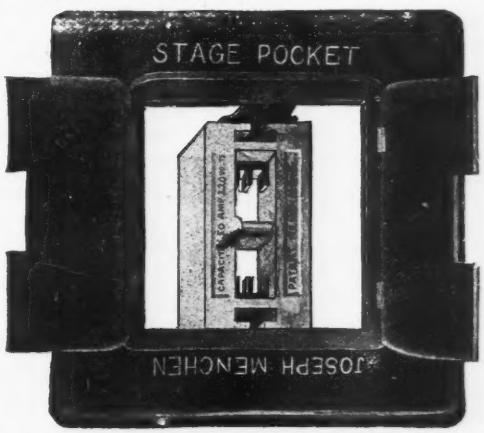

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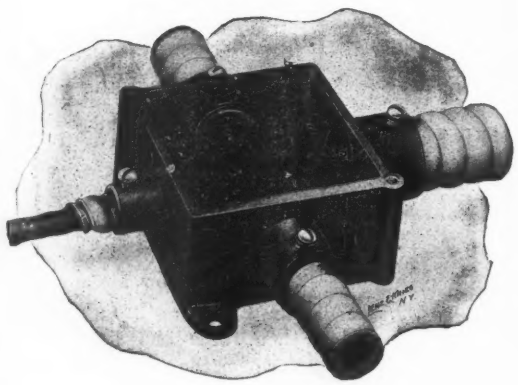

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New York Office, 74 Cortlandt St. WAVERLY PARK, NEWARK, N. J.

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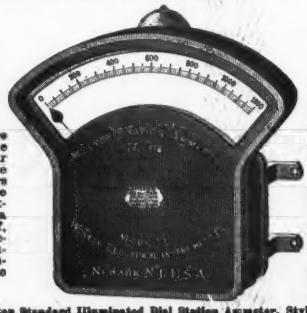
These Instruments are constructed upon the same general principle as our regular Standard Portable Direct-Current Voltmeters and Ammeters, but are much larger and the working parts are enclosed in a neatly designed, dust-proof, cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.



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Portable, Direct Reading Voltmeters and Millivoltmeters, Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct-Current Circuits.

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Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

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List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JUNE 30, 1903.

732,032 Sparking plug; W. Barber, Brooklyn, N. Y.

732,047 Electrode; W. R. Chipman, New York, N. Y.

732,062 Power transmission and control; J. B. Entz, Philadelphia, Pa.

732,088 Insulator for high-tension currents; K. S. Lemstrom, Helsingfors, Russia.

732,098 Central energy telephone system; K. B. Miller, Chicago, Ill.

732,114 Maintaining synchronous rotation of dynamo-electric machines; E. W. Rice, Jr., Schenectady, N. Y.—The method of preventing hunting which consists in opposing, by substantially non-lagging currents, the variation of that component only of the armature reaction which exists as cross-magnetization.

732,130 System of control for electrically propelled trains; E. A. Sperry, Cleveland, Ohio.

732,131 Selective party-line telephone system; A. J. Springborn, Cleveland, Ohio.

732,139 Prepayment wattmeter for three-wire systems; G. G. Tilden, Newark, N. J.

732,141 Electric arc lamp; C. J. Toerring, Philadelphia, Pa.—A long-burning arc lamp, comprising a substantially air-tight globe, a set of slotted tubes, one within the other, having their slots at an angle, and a carbon-holder within the inner tube.

732,144–145 Trolley; J. H. Walker, Lexington, Ky.

732,146 Lubricator; J. H. Walker, Lexington, Ky.

732,147 Telephone transmitter; M. Weissner, Milwaukee, Wis.

732,153 Induction motor; A. E. Averrett, Schenectady, N. Y.—A core composed of magnetic material, and a winding on said core, part of which is iron and part copper.

732,157 Electric railway; A. H. Bedworth, Boston, Mass.

732,170 Electric switch; T. O. Chouinard, Quebec, Canada.

732,171 Brush-holder; A. Churchward, Chicago, Ill.

732,174 Automatic cutout device for electrical transformers; D. C. Conkling, Cincinnati, Ohio.

732,176 Compensating friction in electrical meters; F. P. Cox, Lynn, Mass.—A meter-motor provided with a field magnet and armature coils and an auxiliary starting coil adjustable within said field coil and parallel thereto.

732,182 Electric arc lamp; R Fleming, Swampscott, Mass.

732,196 Terminal socket; C. Leichtenschlag, Berlin, Germany.

(Continued on page 60)

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Telephone, 6063 Cortlandt 128 BROADWAY, N. Y.
Special and periodical audits. Investigations on financial conditions. Examinations and reports of accounts and earnings, reorganizations, consolidations and partnership adjustments. Introduction of efficient methods of accounting adapted to special conditions.

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The only economical turn-down lamp.
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H. T. PAISTE CO.
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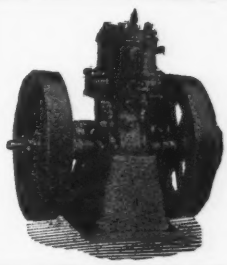
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STATIONARY, MARINE and AUTOMOBILE MOTORS
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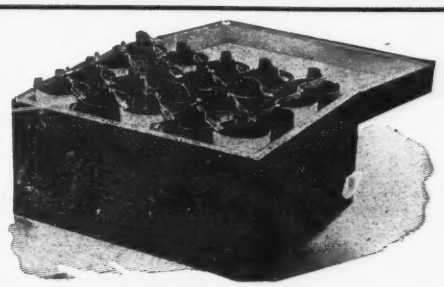
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THAT
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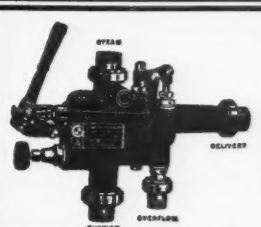
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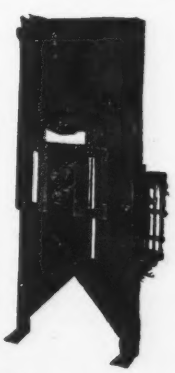
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Are made under the Inventor's personal supervision by
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W. H. C. Regulator, Patent May 1, 1900.
Incorporated 1846. Send for Circulars and Testimonials

PATENTS.

(*Continued from page 59.*)

732,200 Armature; J. A. Little, St. Louis, Mo.

732,201 Electric controller; J. A. Little, St. Louis, Mo.

732,204 Phase transformation; A. D. Lunt, Schenectady, N. Y.

732,211 Shade and reflector for electric lights; O. A. Mygatt, New York, N. Y.

732,235 Electric motor; P. Swan, Calcutta, India.

732,238–239 Automatic regulator for electric generators; W. A. Turbayne, Buffalo, N. Y.

732,240 Brush-holder; L. E. Underwood, Lynn, Mass.

732,247 Controller for electric motors; E. R. Whitney, Swampscott, Mass.

732,253–254 Circuit-breaker; H. P. Ball, New York, N. Y.

732,255 Oil switch; H. P. Ball, New York, N. Y.

732,272 Signaling system; H. G. Brown, Melrose, Mass.

732,273 Electromagnet; C. A. Brust, Memphis, Tenn.

732,279 Electrically controlled perforating machine; H. L. Davis, Washington, D. C.

732,284 Telephone transmitter; E. B. Fahnestock, New York, N. Y.

(*Continued on page 62.*)

For Sale—RAILS—Wanted for Cash.

Generators, Motors, Cars, Engines, Boilers —$300,000 worth listed in JOHNSON'S EQUIPMENT BULLETIN Write for copy No. 13

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One 180 kw., General Electric, 2,300 volts, 60 cycles, single phase, speed 600 R. P. M.
One 180 kw.. Westinghouse, 2,200 volts, 60 cycles, two phase, speed 514 R. P. M.
One 150 kw., Westinghouse, 2,300 volts, 60 cycles, single phase, speed 625 R. P. M.
One 150 kw.. Stanley, 1,100-2,200 volts, 133 cycles, two phase, speed 800 R. P. M.
Two 120 kw., General Electric, 1,040 volts, 125 cycles, single phase, speed 1,070 R. P. M.
One 120 kw., General Electric, 2,080 volts, 125 cycles, single phase, speed 1,070 R. P. M.
One 90 kw., General Electric, 2,300 volts, 60 cycles, single phase, speed 900 R. P. M.
Two 75 kw, General Electric, 2,100 volts, 60 cycles, two phase, speed 900 R. P. M., with switchboards.
One 60 kw.. Westinghouse, 2,200 volts 60 cycles, two phase, speed 900 R. P. M.
Three 35 kw., Thomson-Houston, 1,100 volts, 125 cycles, single phase, speed 1,500 R. P. M.

Street-Railway Generators

Two 500 kw., G. E., 6-pole, speed 300 R. P. M.
Two 300 kw., G. E., 4-pole, speed 400 R. P. M.
One 200 kw., Westinghouse, 6-pole, speed 510 R. P. M.
Two 200 kw., G. E., 4-pole, speed 425 R. P. M.
Two 180 kw., Westinghouse, 4-pole, speed 535 R. P. M.
One 150 kw., Fort Wayne, 6-pole, speed 550 R. P. M.
One 110 kw., Eddy, 4-pole, speed 600 R. P. M.
Two 100 kw., G. E., 4-pole, speed 650 R. P. M.
One 100 kw., Walker, 4-pole, speed 750 R. P. M.
Two 100 kw., Edison, bipolar, speed 620 R. P. M.
One 90 kw., T.-H., 4-pole, speed 700 R. P. M.
One 80 kw., G. E., 4-pole, speed 700 R. P. M.
Five 62 kw., T.-H., type D, speed 900 R. P. M.
One 45 kw., G. E., 4-pole, speed 1,040 R. P. M.

Engines

One 24 x 48 Hamilton Corliss, 450 H.-P.
One 23 x 48 Harris Corliss, 400 H.-P.
One 18 x 48 George H. Corliss, 250 H.-P.
One 16 x 42 Providence Greene, 200 H.-P.
Two 18-30 x 16 Westinghouse compound, 250 H.-P. each.
Three 18½ x 18 Armington & Sims, 250 H.-P. each.
One 18½ x 18 New York Safety, 250 H.-P.
One 10-18 x 20 Payne tandem-compound, 150 H.-P.
Two 14 x 18 Armington & Sims, 150 H.-P.
One 14 x 14 Rice automatic, 125 H.-P.
One 13 x 12 Armington & Sims. 125 H.-P.
One 12 x 36 Harris Corliss, 100 H.-P.
One 12 x 34 Brown, 75 H.-P.
One 12-20 x 12 Westinghouse compound, 100 H.-P.
One 11 x 12 New York Safety, 75 H.-P.
One 12 x 12 Watertown, 100 H.-P.
One 10½-16½ x 12 Armington & Sims cross-compound, 100 H.-P.
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(Continued from page 60)

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732,287 Telephone-hook switch; E. B. Fahnestock, New York, N. Y.

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732,366 Electric igniter; H. G. Mears, New York N. Y.

732 371 Generator for electric igniters; L. J. Le Pontois, New York, N. Y.

732,372 Generator for igniters; L. J. Le Pontois, New York, N. Y.

732,377 Electrical motor; H. Rowntree, Chicago, Ill.

732,386 Friction gear for electric motors; J. B. Wantz, Chicago, Ill.

732,443 Telephone; F. C. Redfield, Nashua, N. H.

732,449 Telephone transmitter and receiver; O. P. Sammons, Dennison, Tex.

732.477 Electric switch; I. G. Watermann, Santa Barbara, Cal.

732,488 Electric arc lamp for constant-potential circuits; J. J. Wood, Fort Wayne, Ind.

732,489 Rheostat for arc lamps; J. J. Wood, Fort Wayne, Ind.

732,495 Trolley; G. E Allen, Pittsburg, Pa.

732,512 Electric railway; E. C. Boynton, Newburgh, N. Y.

732,546 Cotton picker; J. Griffin, Greenville, Miss.

732,559 Electric signal; G. F. Hilton, St. Augustine, Ill.

732,583 Safety device for electric elevators; G. T. Rennerfelt, Brooklyn, N. Y.

732 602 Electric motor for ceiling fans; P. Swan, Calcutta, India.

732,608 Electrical contact controling float; I. G. Watermann, Santa Barbara, Cal.

732,616 Method of applying heat to electrolytes; C. F. Burgess, Madison, Wis.

732,619 Controller for electric hoists; P. J. Darlington, Glenridge, N. J.

732,631 Asymmetric conductor; C. Hambuechen, Madison, Wis.—Comprises an electrolyte which is substantially non-conductive at ordinary temperature and electrodes.

732,644 Switch for double-filament electric lamps; L. Lobenthal, New York, N. Y.

732,648 Telegraphic transmitter; H. G. Martin, Brooklyn, N. Y.

732,654 Means for maintaining synchronous rotation of dynamo-electric machines; E. W. Rice, Jr., Schenectady, N. Y.

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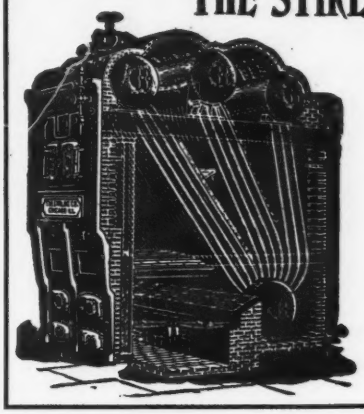

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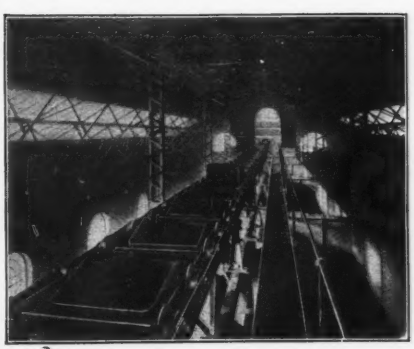

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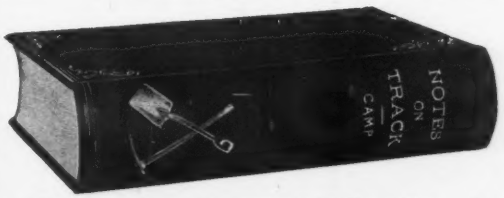

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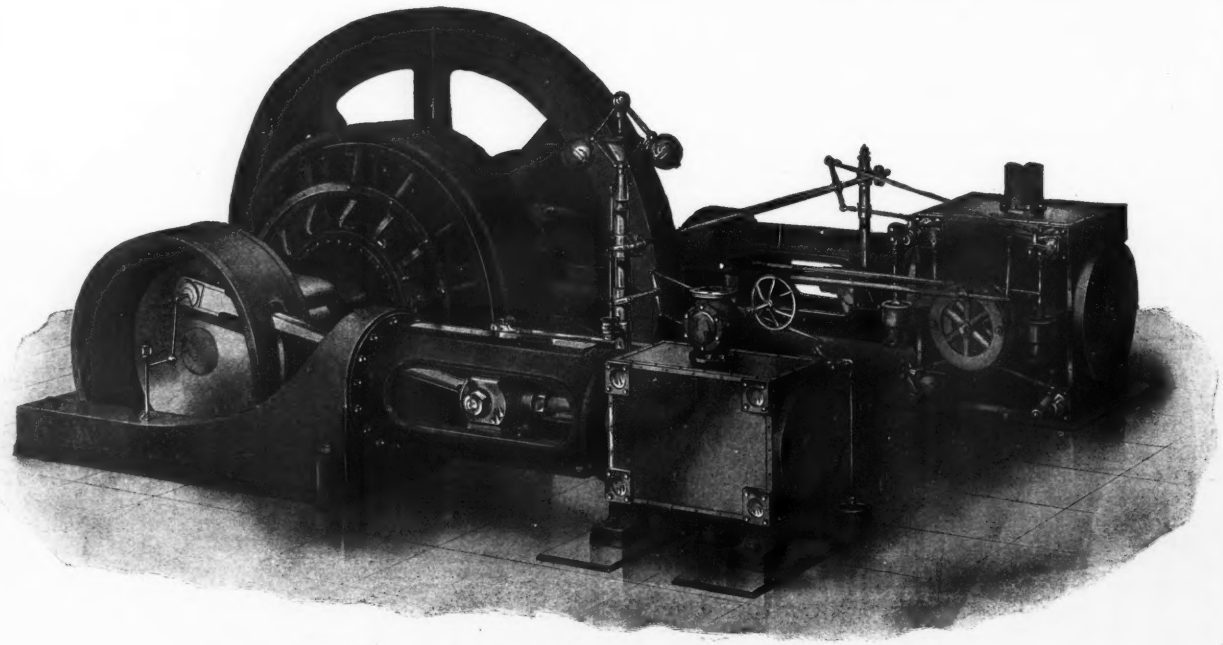

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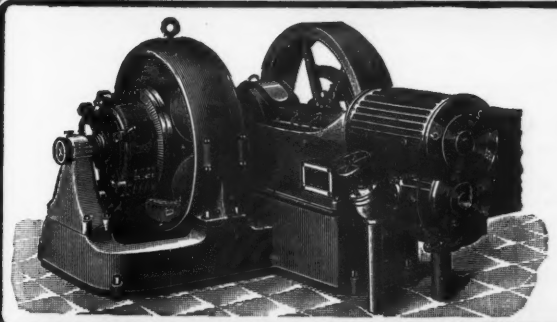

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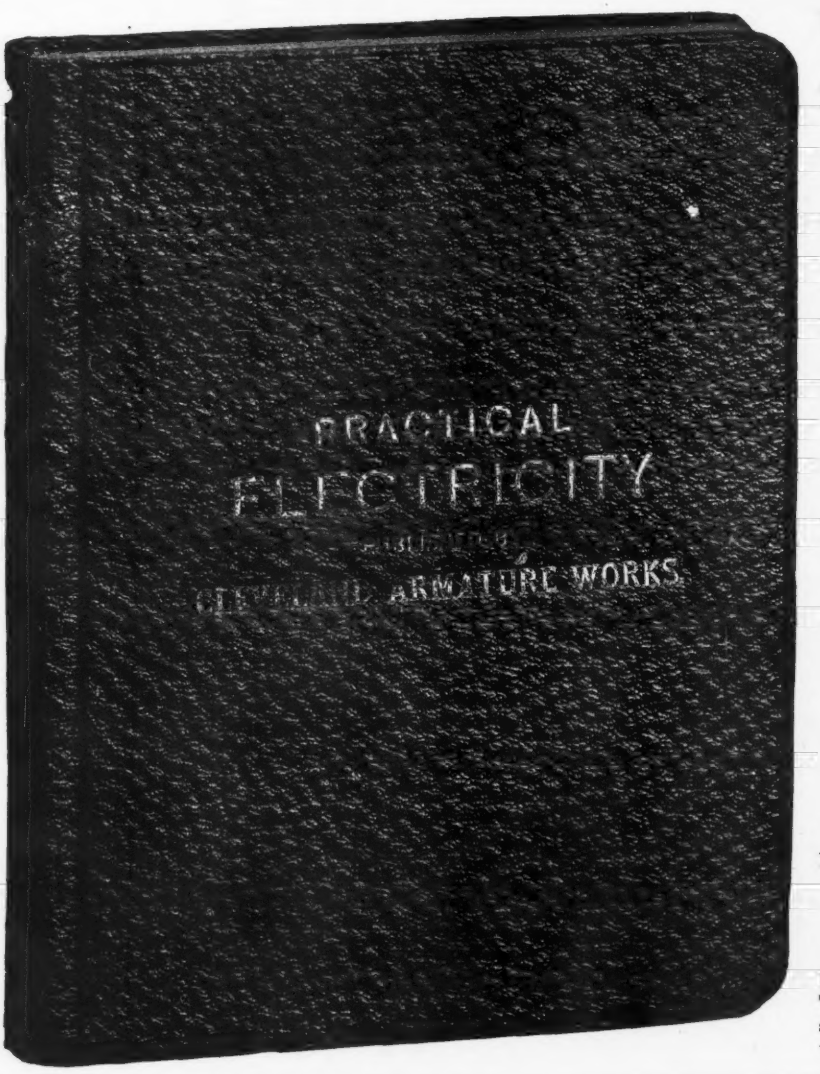

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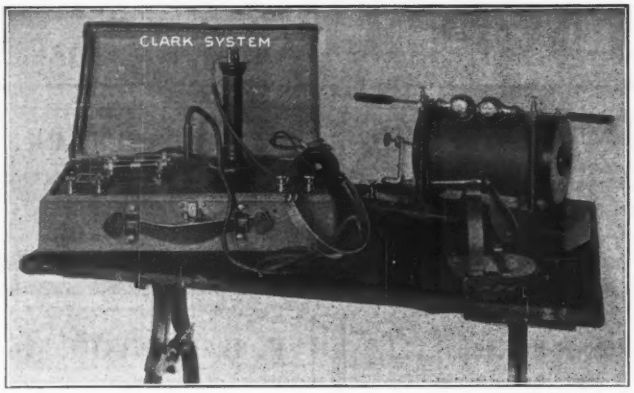

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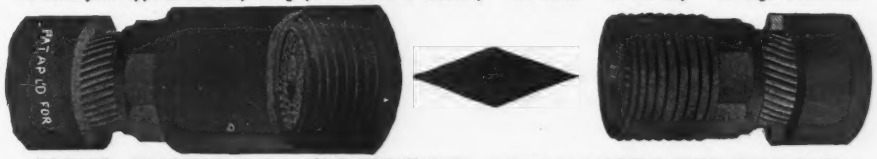
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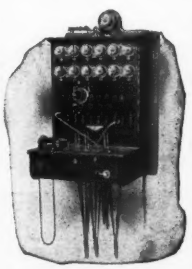

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